Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE ARUNDEL STREET, STRAND, LONDON, W.C.

No. 184.—Vol. XVI. JANUARY, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

The New Short Rifle.—Mark III. pattern of the new short rifle will shortly make its appearance, and it will add another chapter to the unfortunate history of rifles adopted in the British service since small bores first came into use. The new pattern rifle merely aims at removing some of the more obvious defects of the short rifle when first introduced. The alterations do not concern the general structure of the rifle, but are mainly confined to to the sights and the system of charger loading. If one may judge by the patent specification which has been described in these columns the new backsight is much superior to its predecessor. The original arrangement was an inconvenient jumble of mechanism, difficult to operate, and not conducive to taking a rapid aim. The new sight, being the result of practical experience of the older pattern, is likely to prove greatly superior from a mechanical standpoint. The optical aspect of the foresight has been improved by diminishing the obtrusiveness of the protecting horns, but one cannot help prophesying absolute failure for the ridiculous combination of a back notch consisting of a semi-circular groove and a knife-edge pattern of front sight. The abandonment of the V and barleycorn, and the substitution of the U and knife-edge must be regarded as a retrograde step, doubtless engineered by someone whose shooting days are over or else never existed. The new optical arrangement of the sighting points is in harmony with the recent army order which dismisses target practice as a stupid and unnecessary waste of time. The new combination may be well enough in its way for a rough and ready approximate aim; but it would suffer in competition with the older system in a test for fine accuracy. The great advantage of the V and barleycorn is that they are equally suitable for quick approximations as for extreme delicacy of alignment. The new arrangement fails in one direction without showing an improvement in the other. It is well adapted for pistols where the two sights are close to one another and distant from the eye; but the new arrangement, as exemplified on the War Office miniature rifle, has found few admirers, and it would prejudice the chances of a shooter in competition except where the use of alternative devices is disallowed. If the new arrangement ever reaches Bisley the ingenuity of the competitor will doubtless enable him to rise to the occasion.

Apprenticeship in the Gun trade.—The suggestion that the old system of apprenticeship should be revived in the Birmingham gun trade is worthy of the statesman-like instincts which inspire those who are associated with the direction of affairs in the trade. Changes of method in manufacture have come along so rapidly that the older generation of skilled workers have sufficed to provide the craftsmanship which is a necessary complement to the processes which are carried out by machinery. In times gone by when skill in the handling of tools was a kind of religion amongst workmen, every junior aspired to acquire the art of performing the delicate hand operations which were well enough paid to compensate for the years of small earning power, which preceded the journeyman standard of proficiency. Whilst the system of apprenticeship has fallen into disuse amongst the workman class it is regarded as the right method to adopt in the training

of engineers and others, who hope some day to direct practical operations. The gentleman apprentice, after his all too brief three years work in a factory, is but a poor mechanic at the best. He has, however, acquired a certain amount of useful experience which distinguishes him from the man of purely office training, who has never cultivated mechanical deftness. In the case of the young workman an entirely different training is necessary. His apprenticeship is so much time wasted unless he has performed during the period of his probation a sufficient amount of really sound and useful work to enable him to attain a high earning capacity when his training has been completed. The proposals now made recognise that to turn out a good workman it is necesssary that the early efforts should be directed by a foreman who will take a personal interest in the success of the student. A certain amount of work must be spoilt in the process of teaching, and when proficiency has been gained in the carrying out of one process the student must be given to another kind of work where the learning process is continued. The essence of the apprenticeship principle consists in the devotion of the entire working day, to the tasks which must be carried out with plodding care and attention. The output valued in money must necessarily be small, the chief return being a gradual development of skill. Technical classes which aim at showing the underlying theory of practical operations are valuable, because they teach the student to think; but they cannot displace the long hours of labour in the workshop, where physical skill can alone be acquired. Therefore the modified apprenticeship system which has been proposed is good, because it aims at giving workshop experience during workshop hours. A supply of young men should be forthcoming who will consent to forego the higher pay of piecework operations in the machine shop.

The Birmingham Gunmakers' Association.—This Association is to be congratulated on the completion of another year's successful operations, the meeting held on the 16th ult. being the eleventh annual gathering of the members. Mr. W. H. Hughes continues to carry out the duties of chairman, and his rare gift of dealing with matters of far-reaching interest in a sensible and businesslike manner, must be appreciated by those who look to him to express the opinions of the trade. His Association is particularly fortunate in having the close sympathy and co-operation of the Proof House. The two bodies act together the one helping the other, and both striving towards the same end—the betterment of conditions for the gunmaker and the gun worker. It was particularly appropriate that Mr. Hughes should have referred in the course of his speech to the particularly unfair kind of competition which results from the selling by the National Rifle Association of rifles converted from old service weapons. It is not of course possible to lodge any legitimate objection against the utilisation of old material of this kind; but there is a definite grievance in the circumstance that a body supported by public subscriptions, largely derived from gun and cartridge makers, should traffic in firearms at prices which a commercial body could not entertain. If the gun trade wishes to take practical action in the matter it should commence by drawing up a list of gun trade members of the National Rifle Association, and secure the presence of as many of them as possible at the Spring general meeting, to support a resolution condemning the policy of using the Association's funds and credit in trading transactions. The ordinary attendance at these meetings is usually well under forty, so that there should be no difficulty in securing an overwhelming majority in favour of a reasonably framed resolution. This is perhaps a matter where the two Associations of gunmakers might work together. The wishes of a large body of members could not very well be ignored, and lofty as is the attitude adopted by the National Rifle Association it must recognise that it did not come into existence as an army and navy stores, and that so serious a departure from its traditional functions at least requires a few words of justification to the members.

The Army Council on Rifle Shooting.—The Order issued by the Army Council condemning in principle what is characterised as bullseye shooting, is one of the most extraordinary documents it is possible to conceive. The sole explanation which suggests itself to the mind is that the order is a delicate thrust at the National Rifle Association. The latter body occupies an analagous position to the private committee of the gentlemen who ran the military tournament some years ago, with the help and collaboration of the War Office. In due course the military authorities decided that the sound and practical organisation which had been formed was ripe for taking over, and the private management was obliged to surrender its functions. It has been whispered of late that the War Office is desirous of identifying itself with the Bisley meeting in other ways than by supplying free cartridges to the competitors. The N.R.A. has grown into rather a big boy, and it exercises official authority in matters, which might well be regarded as falling within the sphere of army management. The Army Order condemning the form of practice which has been stereotyped at the Bisley meeting, may be intended as a prelude to the withdrawal of a part or the whole of the official support which has hitherto been extended to the N. R. A. It certainly sets the ball rolling in a very effective fashion, and it will at least serve as a reminder that War Office susceptibilities and views must not be disregarded. It seems impossible to treat the Order seriously from the point of view of rifle shooting. A proper knowledge of the rifle and skill in its use, cannot be acquired otherwise than by firing under approved range conditions. The good shot at the target will always be the best exponent of snap-shooting and firing over unknown distances, and practice in this direction must be in addition to, and not instead of, the routine work at the range. If soldiers are to be taught snap shooting the ·22 rifle is more suitable for the purposes of instruction than the service weapon. The air-rifle would afford an even greater safeguard against the danger of stray shots, but it will be years before such simple truths are officially recognised.

THE WAR OFFICE AND INVENTIONS.

The grievances of the genuine inventor with regard to the treatment his proposals receive at official hands will be difficult to remedy so long as a large porportion of the ideas which are put forward are the notions of inexpert outsiders. Anyone who has the slightest acquaintance with manufacture, knows full well that the smallest change produces a very great disturbance, and that new ideas of proved merit must frequently wait their turn for years before there is a chance of adopting them. It is, for instance, well-known that the service rifle and cartridge are hopelessly bad in many details which could be set right without the need to invent or make new discoveries; and yet we continue using the same inefficient bolt mechanism and the same bad cartridge, though their defects were well-known and understood fifteen or more years ago. Public opinion might force improvements in such directions as this were it better guided by the public press; but the newspapers are so hopelessly astray when they do attempt to interfere, that their influence is of very little value, even when a clear case for reform has been made out.

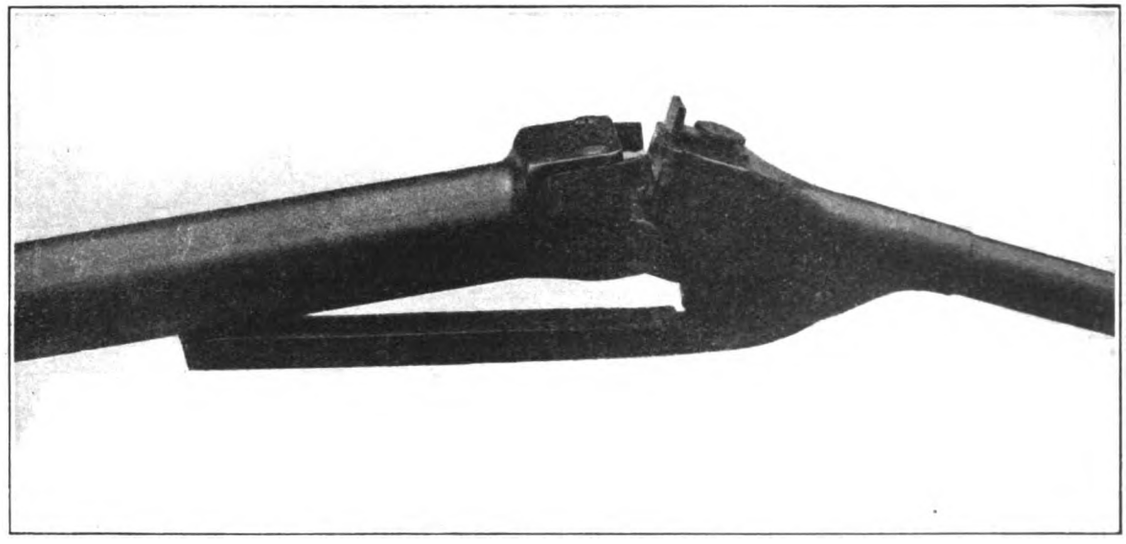
The War Office is in the difficult position of being found fault with whatever it does. It must not express unofficial opinions concerning the most foolish proposals which are put forward, and the lengthy procedure laid down in the memorandum to inventors is irksome to those who think that their own particular business should take precedence of everything else. A witty correspondent of one of the evening papers recently described his personal experiences in submitting to the War Office a model of a shell, the invention of a friend. He was conducted by a lackey in gold lace to a series of persons who were designated by various cryptic letters and numbers. All these persons carefully inspected him through various forms of face glazing, and thus he gradually progressed, until he came to another specimen of the optician's art. He had passed from pince-nez to spectacles, spectacles to monocle, monocle to pince-nez, until he fully expected the next door to open and disclose a gigantic monocle with arms and legs—but no head of course. However, there was a head, but it was rather a tired one, and wore a wearied look, and gazed upon him with such a suggestion of utter tiredness that he felt an absolute "low-down outsider" for worrying it; but, being there, he decided to go through with the business. The visitor was astounded to find that it would take six weeks to receive a reply, and that a year would elapse before a definite answer would be forthcoming. He then went to the Vickers Company, where he appears to have met a real live man who told him at once that the idea was worthless. The difference between this inventor's representative and the kind of man the War Office is in the habit of meeting is that the one was a reasonable and practical man, whereas most of them refuse to take no for an answer, and insist on the merit of their invention. If the War Office, in kindness of heart, gave off-hand decisions to the ordinary inventor the latter would at once write to the *Times* and complain that some jackanapes junior officer had dismissed the fruits of years of labour with contemptuous indifference.

The Fitzgerald gun provides a worthy example of the kind of invention which the War Office is bound to treat as though it had serious importance. The *Evening Standard*, which appears to have interested itself in this invention, announced that in view of War Office apathy it had itself arranged to give it a practical trial. The main idea in the weapon seems to consist in the application of a secret cooling process for maintaining a low barrel temperature. The secret does not, however, appear to have been well kept, for when the gun made its appearance at Nunhead, it was at once obvious that the secret consisted in distributing the heat of firing over eight barrels and an immense block of metal at the breech. The preliminary writing up of the gun filled many pages of the earlier issues of the paper, and the articles were plentifully sprinkled with references to War Office indifference. The result of the trials was described by our enterprising contemporary as a distinctly qualified success. Where the success came in is difficult to see, but the qualifications were exceedingly apparent. Such incidents as this, will not help to open the doors wider for those whose inventions are backed by sound practical knowledge.

It may in fact be laid down as an axiom that useful invention is only possible by those who have an intimate and life-long acquaintance with the mechanism or processes they hope to improve. Where the War Office deserves the indifferent reputation it has acquired is that the technical operations are governed by officers, who are deprived by the regulations of the service from applying themselves continuously to one kind of work. The artillery and engineer officers, who supervise the technical operations of the War Office, are exceptionally gifted men, well trained, and in most cases far above the general average of intelligence, but they lack the practical knowledge which comes with years of concentrated effort. When they have completed a few years service in some special branch of work they go back to their regiments, where they make but indifferent officers, having lost touch with regimental duties. They return in due course to special work; and the chance opening that offers may involve an entirely different class of labour from that which previously engaged their attention. We have in the Inspectors of Explosives and in the officers who have entered private employment, a sample of the great skill which the military officer is capable of acquiring when left undisturbed. If the War Office system of employment were radically altered so that the engineering and ordnance sections could be recruited from men combining in their youth shop experience with technical education, such as the government factories and service colleges provide, a vastly better state of affairs would arise. Its effect upon design would be that War Office inventions and designs would be sounder and more practical than at present, whilst ideas submitted by outsiders would be better understood, and would enjoy greater opportunities of adoption should they prove sound in principle.

THE KYNOCH AIR RIFLE.

A good deal of interest was aroused a year or so ago by the announcement that the Kynoch Company were engaged in designing an air-rifle. The extraordinary success of their ingeniously designed slug some years previously had already connected their name most prominently with the rise of the air-rifle as a serious weapon for target practice. As soon as the new rifle was ready for the market, a letter was addressed to the Company asking that a specimen model should be sent to this office for examination and report; and it accordingly gives us great pleasure to reproduce the accompanying illustrations. The first shows a general view of the rifle, and the other a more detailed view of the breech mechanism, with the action unlocked, ready for compressing the propelling spring. It will be seen that Messrs. Kynoch have combined the breakdown principle with a very ingenious locking device, the breech being maintained in the closed position, by a pair of powerful spring-operated catches on either side of the action. These catches pivot on the two screws, which can be seen on the top side of the action, and they extend forwards so as to hook into grooves formed on the sides of the barrel face. The engaging surfaces are sloped in reference to one another, so that the forcible depression of the barrel frees it from the retaining catches whereby it drops into the position shown in the illustration. The air-tightness of the breech is secured by coning the entry to the barrel, and providing on the face of the body a projecting brass disc with rings and other arrangements for securing an air-tight joint. The backsight lies immediately above the breech, and elevation is given by turning a screw. The barrel is rifled by means of the special process described in our patent columns last month, the specification being ten grooves with a twist of one turn in 15 inches. The trigger is provided with an adjustment screw, and the sear mechanism is well supported and provided with hardened faces, so as to give permanence and security to the adjustment. The rifle has been named the "Swift" and the official weight is 6½ lbs., though the sample actually delivered weighs 6lbs. 14oz. The distance from the trigger to the backsight is just over nine inches, which ensures good optical conditions. The foresight is eighteen inches forward of the backsight.



Apart from the mere details of construction the rifle as a whole may be characterised as a piece of very sound workmanship. It is in most pleasing contrast to the poorly made air guns, which in the early days earned such a bad reputation for the whole class of weapons deriving their propulsive power from air compression by springs. The more recent fashion of making air-rifles on sound lines, as regards construction and design, which set in when Birmingham adopted air rifle shooting as an evening pastime, is well exemplified in the rifle under notice. It is finished in thoroughly good style, it is well sighted, and it will bear taking apart without disclosing defects to the critical eye. The rifle is in fact a decidedly creditable achievement, and it will doubtless be much appreciated by those who have learnt how valuable is the air-rifle as an auxilliary to range practice with more powerful weapons. The retail price of the rifle with pistol stock has been fixed at 50s.

THE DISCOVERY OF NITROGLYCERINE.

By GEORGE W. MACDONALD, M.Sc.

THE history of explosives is so largely hidden away in the archives of scientific societies that few active workers of the present day know where the original documents are to be found, let alone what they contain. Some of the earlier classical papers announcing discoveries which have been of far-reaching importance in the development of modern explosives, are as a rule neither easily accessible nor generally consulted, and it is consequently not without interest to refer to them somewhat in detail, as they not infrequently contain records of observations and experiments which one is usually apt to consider the results of much later investigation. It is natural to deal, in the first place, with Sobrero's discovery of nitroglycerine.

Ascanio Sobrero, Professor of Chemistry in Turin, was born October 12, 1812, at Casale, and died in Turin, May 26, 1888. His discovery of nitroglycerine was communicated to the Academy of Science in Turin in a paper dated Feb. 21, 1847, and entitled "Some new fulminating products obtained by the action of nitric acid on some vegetable organic substances." Sobrero had already shown that the action of nitric acid upon sugar, dextrine, lactine and mannite produced bodies of an explosive character, but he was surprised to find that glycerine, when nitrated, produced a violently explosive body. In what succeeds it is possible, with slight abbreviations, to follow closely his original paper.

"Glycerine, under certain circumstances, is very readily oxidised. Nitric acid reacts on it very energetically producing oxalic acid, and, in all probability, intermediate compounds of a more complicated nature are formed. If concentrated nitric acid or a mixture of two volumes of sulphuric acid of 1.84 sp. gr. and one volume of nitric acid of 1·5 sp. gr. is added to glycerine, concentrated to a syrupy condition, a very violent reaction is set up, with the evolution of very considerable quantities of oxides of nitrogen. If, however, we reverse the process and pour the glycerine into a mixture of the acids kept at a temperature of several degrees below zero, the reaction is quite different. The glycerine goes into solution in the mixed acids, and with greater readiness by constant stirring. When the glycerine has been completely dissolved the contents of the vessel are poured into distilled water at the ordinary temperature. Drops of an oily liquid immediately collect at the bottom of the vessel containing the water, and finally join together to form a distinct layer. This oily liquid is a new compound which I propose to call *Piroglycerina*. (Hereafter nitroglycerine will be used instead of Sobrero's original name). Nitroglycerine can be readily freed from adherent acid by washing with water, in which it is insoluble, and, on placing it in a vacuum over sulphuric acid, the traces of adherent water are absorbed and a transparent liquid obtained. It is of a light yellow colour, highly refractive, and remains liquid down to a temperature of – 20°C. It is soluble in alcohol and ether and may be obtained in a high state of purity by dissolving it in alcohol and reprecipitating with water, or by allowing its ethereal solution to evaporate spontaneously. The properties of nitroglycerine are very remarkable. It has a specific gravity of 1·6 at 10°C. When traces of water are present it loses its transparency. Bodies which are easily oxidised rapidly decompose nitroglycerine. It detonates when brought into contact with metallic potassium, and evolves oxides of nitrogen in contact with phosphorus at 20° to 30°C, but at higher temperatures it ignites with an explosion. Copper is oxidised by it with the production of oxides of nitrogen. It is not attacked by concentrated sulphuric acid or nitric acid to any marked extent, and aqua regia only acts on it when heated. It decomposes hydrochloric acid with the production of chlorine, and becomes of a yellow colour on the addition of strong bases. Caustic potash decomposes it, when heated, producing ammonia. When heated nitroglycerine decomposes. A drop heated on platinum foil ignites and burns very fiercely. It has, however, the property of detonating, under certain circumstances, with great violence. On one occasion a small quantity of an ethereal solution of nitroglycerine was allowed to evaporate in a glass dish. The residue of nitroglycerine was certainly not more than 2 or 3 centigrams. On heating the dish over a spirit lamp a most violent explosion resulted and the dish was broken to atoms. On another occasion a drop contained in a test tube was being heated when it detonated with great violence and pieces of glass severely cut my face and hands and also injured others standing in the room some distance away. The safest plan for demonstrating the explosive power of nitroglycerine is to place a drop upon a watch glass and detonate it by touching it with a piece of platinum wire heated to low redness. Nitroglycerine has a sharp, sweet, aromatic taste. It is advisable to take great care in testing this property. A trace of nitroglycerine placed upon the tongue, but not swallowed, gives rise to a most violent, pulsating headache, accompanied by great weakness of the limbs. A dog was given a few centigrams of nitroglycerine admixed with milk. It soon after began to foam at the mouth and then vomited. Despite the fact that the greater part of the nitroglycerine had thus been eliminated from the system, within seven or eight minutes the animal had fallen down and almost ceased breathing. A dose of olive oil and ammonia was then administered. The animal revived somewhat, and remained for some two hours, whining, trembling violently, and beating its head on the wall. A *post mortem* examination showed that the vessels of the brain and heart were suffused with blood and much distended. Similar results were obtained with rats and guinea-pigs.

"The violence of the decomposition of nitroglycerine has prevented me, up to the present, making an analysis of this body. One experiment in this direction resulted in the violent ejection of the copper oxide from the combustion tube. On theoretical grounds, seeing that it is made in a similar manner to other explosive bodies such as nitromannite, etc., I am inclined to think that it is produced by the replacing of two equivalents of water by two equivalents

of the anhydride of nitric acid. As no residue remains after detonation, it follows that nitroglycerine is converted, on decomposition, entirely into gases. If this body be considered as a nitrate of glycerine, it might perhaps be possible to produce by double decomposition a new series of compounds of the fatty acids with glycerine. I have made some experiments in this direction by heating nitroglycerine with a soap solution but have not been able in this way to produce an oleate. It is perhaps possible that an intermediate compound is produced by the elimination of one of the nitric acid groups.

"The explosive compounds obtained from lactine and mannite are very similar to nitro-sugar which I have previously prepared. They are both soluble in alcohol and ether and insoluble in water. Nitro-mannite crystalises in small needles, whilst the other compound is amorphous. Like nitro-sugar they liquefy when heated gently and decompose without explosion. They, however, explode when rapidly heated to a high temperature."

Sobrero adds a further note some five months later :—

"The greater number of these explosive bodies have shown themselves to be unstable. It is only a question of a longer or shorter time before they begin to decompose with production of nitrogen dioxide. The nitro-compounds of sugar, lactine and dextrine all behave in this manner. Nitro-mannite, alone, during the course of four months appears to show a perfect stability. Nitroglycerine kept below water is covered, after some months, with little bubbles of gas which I believe to be nitrogen dioxide. It is perhaps hardly necessary to add that heat favours this decomposition. The nitro-compounds of sugar and lactine which appeared to be stable during the winter months began to show signs of decomposition during the greater heat of summer. It remains to be added that water, standing for a month in contact with nitroglycerine, besides being acidic, showed very distinct traces of the presence of cyanogen."

THE LATE MR. V. T. MITCHELL.

THE death of Mr. V. T. Mitchell, which took place in his 49th year at the London Hospital on Tuesday the 17th ult., removes one of the early workers in the commercial establishment of smokeless sporting powders. What was at first regarded as an ordinary influenza cold rapidly developed internal complications, and an immediate removal to the hospital was deemed necessary. On arrival it was found that the patient had become unconscious, and he died a few hours later. At the funeral, which took place by his express wish at the Crematorium, Golders Green, there were present, in addition to his immediate relatives, representatives from the Schultze Gunpowder Co., Ld., Messrs. Joyce and Co., Ld., and amongst the more personal friends Mr. John Robertson, also Messrs. E. G. Mackenzie, F. C. Borer, J. C. Wright, Holding and Bradford.

By the death of Mr. Mitchell there passes away one of the few remaining workers whose lives were bound up with the introduction and establishment of smokeless powder. The early days of smokeless powders are so rapidly passing into history, and the chief actors are so quickly dropping out of the ranks, that it is interesting to recall Mr. Mitchell's own share in the pioneer work that formed a necessary preliminary to the acceptance of sporting smokeless powder as a commodity in general consumption. It was in the beginning of the year 1880 that V. T. Mitchell entered the employment of the Schultze Gunpowder Company, when the chances of smokeless powder ever coming into successful use seemed very small indeed, notwithstanding the twelve years of hard work which had even then been lavished upon it. In the year 1864 Captain J. E. Schultze had visited England at the invitation of Mr. James D. Dougall Sen., and tried, but without success, to form a company. Negotiations were, however, continued and eventually on the 2nd of July 1868 the Company was registered. By 1880 the total sales of smokeless powder in the world did not exceed 8,000lbs. ; but from that date the directors had something more tangible than hope to go upon, and the demand increased rapidly. The capital of the Company was at the time only £14,550, held by nineteen shareholders ; but so confident were the directors that their loans to the Company were upwards of thirty thousand pounds without security. Mr. R. W. S. Griffith was just then beginning to lay the foundation of a reputation which will last as long as the use of nitro compounds endures, Mr. H. T. Withers, most urbane of diplomats, Mr. Clement Dale, the hard working retired Indian service barrister, who was to be found at his desk every day from 9.30 till 6.30 without intermission, and Mr. V. T. Mitchell, the hard-headed young north countryman formed a quartett which dovetailed together for successful working in a manner that it would have been difficult to equal. Each had his own particular branch, and to Mr. Mitchell fell the important work of touring the country to open new accounts. The rapid introduction of breech loaders, and the greater interest taken in game rearing about this period, were undoubtedly helpful ; but in striking evidence of Mr. Mitchell's capacity for work was the fact that in a very short time over four hundred new customers were secured. It is a remarkable fact that although less than thirty years have elapsed, the pioneers of smokeless gunpowder have almost without exception passed away, although most of them lived to see their efforts crowned with success.

Of all the wonderful things that have happened during the period in question none probably is more wonderful than the production of gunpowder by chemical reactions, instead of by uniting the old ingredients as a mechanical mixture. The new idea was converted into practical form for sporting use long before it had been adopted for war, but the fortunes of the pioneers were for a time at such a low ebb that in the two small rooms used as offices candles were employed to save the expense of gas. It was in the Schultze office that these things happened, and no one can fairly say that the pioneer work done in smokeless powders did not influence the far greater changes that were so soon to take place as a result of the proved success of nitro powders. Mr. Mitchell was certainly a missionary in a very great cause.

ROUND THE TRADE.

Captain J. H. Hardcastle has contributed an interesting article on the subject of the pointed bullet to the December issue of the Journal of the Royal Artillery Institution.

A correspondent asks us to mention his wish to secure a copy of the edition of the *Treatise on Ammunition* which appeared previous to the 1897 issue; he thinks in 1883 or 1884.

L' Echo de L' Industrie, a Belgian periodical dealing with engineering matters, contains in its December issue an interesting article summarising the state of the arms business in Abyssinia.

From the Birmingham Small Arms Co. Ld. has been received a recent edition of the pamphlet describing the improved B. S. A. air rifle, the same containing particulars of the various models, prices of spare parts, and instructions for use.

An inquest recently held in Manchester illustrated the necessity for taking exceptional precautions to ensure that when explosive charges have been used for breaking up old iron, a careful examination should be afterwards conducted to see that the whole of the charges have properly ignited, as otherwise great danger may ensue from the presence of unfired cartridges amongst the scrap metal.

A pleasant little dinner was held in London last month for the purpose of celebrating the amalgamation of the B. S. A. and Eadie interests in the cycle trade. Mr. Albert Eadie, who took the chair, may now be regarded as a member of the gun trade; and it may be hoped that the particular branch of gunmaking which he represents, will gain strength by association with his vigorous personality.

The negotiations between a Cardiff sub-committee and the Home Secretary concerning the carriage of explosives through the streets of that city has resulted in the adoption of a series of bye-laws. The Home Office was unable to adopt the whole of the suggestions made by the local authority, as they would have inflicted undue restrictions on trade. The amended bye-laws have accordingly been accepted; but the local authority feels that risks are still being run by the inhabitants of the city. No alternative route is, however, available for the carriage of explosives, and the proposal to limit their passage to night time was refused, on the ground that such a procedure would introduce greater dangers than those it was hoped to remove.

The new scheme for binding apprentices to learn gunmaking provides that the boys should be apprenticed for four years, under workmen who can be recommended by their employers as skilful in their respective branches of trade, and of good character. The wages would be—first year, 5s. per week, 3s. to be paid by the instructor and 2s. by the Guardians of the Proof House; second year, 6s. per year, 5s. to be paid by the instructor, and 1s. by the Guardians; third year, 9s. per week, to be paid by the instructor fourth year, 12s. per week, to be paid by the instructor. The hours to be nine per day, and arrangements will be made for every appprentice to attend a class for suitable theoretical instruction upon two evenings a week at some school; the boys to undergo an examination once a year to test their progress, and all boys who make 90 per cent of attendances to receive a prize. On the completion of his apprenticeship the boy will undergo a final examination, and if the result is satisfactory the man to whom he has been apprenticed will be paid £10 by the Guardians. A certificate of merit, signed by the workman to whom the boy has been apprenticed and the chairman of the Guardians of the Proof House, and the secretary, will be given to apprentices who have passed the final examination. It is also suggested that theoretical classes shall be formed for young men and others connected with the trade.

It has been announced that the directors of the Schultze Gunpowder Co., Ld., have decided not to pay a dividend on the preference shares, for which the regular date was the 31st ult.

At an extraordinary general meeting of the Nobel-Dynamite Trust Co. Ld. held on the 6th ult., the resolution amending the articles so as to give the holders of preference shares power to consent to an increase of the preference share issue was duly confirmed.

A serious explosion occured in the pressing house of Messrs. Kynoch's Worsbrough Dale black powder mills on the 12th ult., by which two men lost their lives, and the manager, Mr. J. G. Sealy, and others were injured by the explosive effects produced some distance from the immediate seat of the accident.

Reference was made on the 18th ult., at a meeting of the Birmingham Chamber of Commerce, to the action of the War Office in selling obsolete military rifles at eighteenpence each, the same being resold, converted into miniature weapons, at prices which could only exist under conditions of subsidised competition.

The programme of the Miniature Bisley Meeting, to be held in the Bunhill Row drill hall from the 21st to the 25th inst., has now been circulated, and the committee draw the special attention of competitors to the rules governing the rifles to be used, these including the objectionable clause of a minimum 8lbs. weight, to which reference was made in our previous issue.

Captain M. B. Lloyd has issued the long-delayed report concerning the explosion which occured during the thawing of some gelignite on the 26th February, 1906. The matters arising from this accident have been exhaustively dealt with during the past year; but as the question is now settled and done with, it is sufficient to record the publication of the report, and to state that it contains a comprehensive statement of the technical questions which arise in connection with the presence of mercuric chloride in explosives.

A prospectus showing the final conditions for the national air rifle team contest and individual championship has been issued by the committee of management from the Secretary's office, Imperial Arcade, Dale End, Birmingham. Exceedingly liberal prizes are offered, and the competitions are likely to arouse great interest. It is held under the auspices of The National Rifle Association, The Society of Miniature Rifle Clubs, The National Air Rifle Association, The Welsh National Air Rifle Association, and The National Service League.

The annual report of the Birmingham and Provincial Gunmaker's Association shows that the funds in hand amount to some £460. It might, however, be pointed out that the form in which the accounts are kept would be improved by separating revenue and capital. The contra entries are somewhat confusing upon the present basis of working, a defect which would disappear if the receipts and expenditure were shown on a profit and loss basis, and assets and liabilities in a separate balance sheet. The report of the year's working shows that many important questions have engaged the attention of the Association.

Mr Walter Winans, whose artistic leanings are well-known, has sent out in the form of a Christmas card a most beautifully prepared engraving showing a boar of tremendous size shot by him and hung up to show its dimensions. Though above the average height Mr. Winans is dwarfed by comparison with the game he has shot. Another drawing, coming from the same source, has been prepared from a most beautifully executed copper engraving signed by Mr. G. Sydney Hunt. Mr. Winans is shown standing in the ready position presumably awaiting the rush of a boar. Both for artistic and personal reasons an engraving of such exceptional merit should be highly prized by the collector.

LECTURES TO YOUNG GUNMAKERS.

No. XLVIII.—A COMPARISON OF SUNDRY RECOIL OBSERVATIONS.

A RECENT issue of *The Field* contained an article on recoil of considerable interest to those who concern themselves with the interpretation of the experimental results which serve to test the behaviour of sporting cartridges and ensure satisfactory conditions of loading and gun construction. The article in question assembled a number of past measurements of recoil in the curve which is here reproduced by permission, and it sought to establish certain general relations between the recoil of a wide range of shot charges and the appropriate weight of gun for giving with each a fair average of recoil. It is necessary to go back some years in order to appreciate the important advances which have been made with a view to giving to measurements of recoil an absolute value in harmony with the quantity of charge employed, its behaviour in the gun and the weight of the gun itself.

The older methods of taking recoil were of a somewhat rudimentary nature and most of them suffered from the disadvantage that recoil was made a separate test, so that it never formed part of the series of measurements for recording the behaviour of a cartridge. Only enough need now be said of past methods to show how recent work follows from the earlier attempts to get at the truth. The very early experimentalists endeavoured to measure recoil by mounting the gun on a carriage, so that the backward movement carried a known weight up an incline of definite gradient. This measured only a part of the recoil, as was shown by alternative apparatus with a level bed, the carriage coming to rest after a very few inches of travel by ordinary frictional resistance alone. Journée hit off the brilliant idea of hanging a gun upon strings, and measuring by means of the chronograph the rate of the backward movement due to firing the cartridge. This test lay dormant for many years by reason of the complicated nature of the experiment. The late Mr. Griffith revived it a few years later, and he published some highly valuable results. Mr. Jones had shown however, in the laboratory of the Smokeless Powder Company at Barwick, that recoil measurements to be most instructive must be carried out in combination with the usual tests of a cartridge. He had mounted the regulation proof barrel on a carriage travelling on a horizontal bed, so that every measurement of velocity and pressure was accompanied by a simultaneous record of distance travelled in recoil. Variations due to weather and so forth influenced the free run of the wheels and made it impossible to calibrate the instrument so as to give results in true units day by day and year by year. Comparative results were, however, always obtained. Variations of shot charge and velocity produced their due relative effect upon the recoil registered, and recoil thus became a check upon the other records obtained, viz., pressure and velocity. A weak cartridge showed a weak recoil, recoil thus serving to confirm or discount the other tests, which like most shooting experiments are more or less subject to slight eccentricities.

When Mr. Houseman came along with his pendulum gun, weighing 50lbs. and delicately suspended upon wires, the recoil test was rendered capable of giving results as absolute as those of the delicate Journée method, without, however, using a chronograph. The Houseman gun like that used at Barwick was capable of being used in combination with the usual tests for velocity and pressure. The Journée method thus retained its position as a means of testing the characteristic recoil of an ordinary gun or rifle, whilst the Houseman method became a recoil test for 12-bore or other cartridges when fired from a special proof gun. The two purposes are entirely distinct, but the *Field* are the only experimentalists in this country and probably in the world, who have so far overcome the mechanical difficulties of the Journée test as to be able to employ it without difficulty on any work that may turn up.

Coincidently with all this work of mechanical invention the theoretical study of recoil had also been much advanced. The more accurate the methods of measurement the greater the inducement to define their scientific foundation. Journée propounded the belief, based on actual shooting tests by a variety of individuals, that recoil as a physical sensation could be expressed by its measurement in foot-lbs. of energy. His conclusions were for many years adopted because of their obviousness. Recoil when all is said and done is merely matter in motion, and the foot-lbs. energy unit, or the corresponding metric measurement, must clearly distinguish high from low recoils. A shooter for instance who fires high and low charges from the same gun will notice a difference in the recoil produced, and this difference would be expressible in scientific units, whether they be velocity of movement, momentum or foot-lbs. Because, however, the physical effect of recoil goes up and down as the energy varies, it does not follow that the same foot-lbs. energy of recoil will produce the same effect on the shoulder under all kinds of conditions. It is now strikingly clear that though a duck gun of considerable weight, firing a full charge gives a very heavy recoil, the shooter who fired a charge giving the same foot-lbs. recoil from a light game gun would remember the unpleasant experience for a life time.

Journée in showing us how to measure velocity of recoil incidentally but accidentally put us on the right track. Houseman never got so far as velocity, but he rejected foot-lbs. and adopted momentum units. He did this because his own test gun weighed 50lbs., and he could only convert its readings into foot-lbs. of energy, by assuming a particular weight for the shooter's gun, and whatever weight might be chosen it was always likely to be something different from the gun in actual use by the shooter. In the old days of guns mostly weighing 7 lbs. it was sufficient to say that the recoil was so many foot-lbs. in a 7-lb gun; but this did not answer the question: what is it in my

gun? He accordingly chose a unit, comprising the product of mass and velocity, but his figures were meaningless to all but persons with a scientific education. The subject bristled with difficulty, because the recoil of a gun varies with its weight, and, therefore, a tangible unit can only be adopted by assuming a particular weight of gun. The *Field* endeavoured to overcome this difficulty by issuing a table which converted each measured amount of recoil on the proof gun into four values of recoil velocity each applicable to a specified weight of gun. This cleared the way for stating recoil in a unit of which the mind could form some kind of mental estimate. If the shooter's gun weighed 6¾lbs. he would be told the rate at which his gun jumped against the shoulder. Further analysis of the velocity method of stating recoil showed that the heaviest and the lightest guns when firing charges found by practice to be suitable, gave approximately the same rate of recoil, although the number of foot-lbs. went up or down in proportion to the weight of the gun.

The issue of the new table soon raised the question, as to what could be treated as a normal rate of recoil for shot guns? It had already been ascertained that high power express rifles of all calibres gave about 17 f.s. rate of recoil. Military rifles from which more cartridges are fired gave recoils in the region of 10 f. s., a low rate of movement which seems to take due account of the more punishing blow which is inflicted on the rigid shoulder of a man lying prone. When military rifles are converted into sporting weapons the weight is reduced about two pounds, with a consequent increase of recoil, which shows that the kind of use to which a weapon is put influences the estimation of what is a reasonable amount of recoil. The shot gun may clearly have a higher recoil than the military rifle, because it is fired in the standing position, where the shoulder displays a maximum of resiliency. The fact that the game gun is fired by a sub-conscious movement, as distinguished from the deliberate style of target shooting, again justifies a higher recoil than would be desirable in a military rifle. Compared with express rifles the shot gun should have a lower recoil, because the covert side sportsman fires as many shots in a single drive as the big game shooter may have occasion to discharge during an entire expedition.

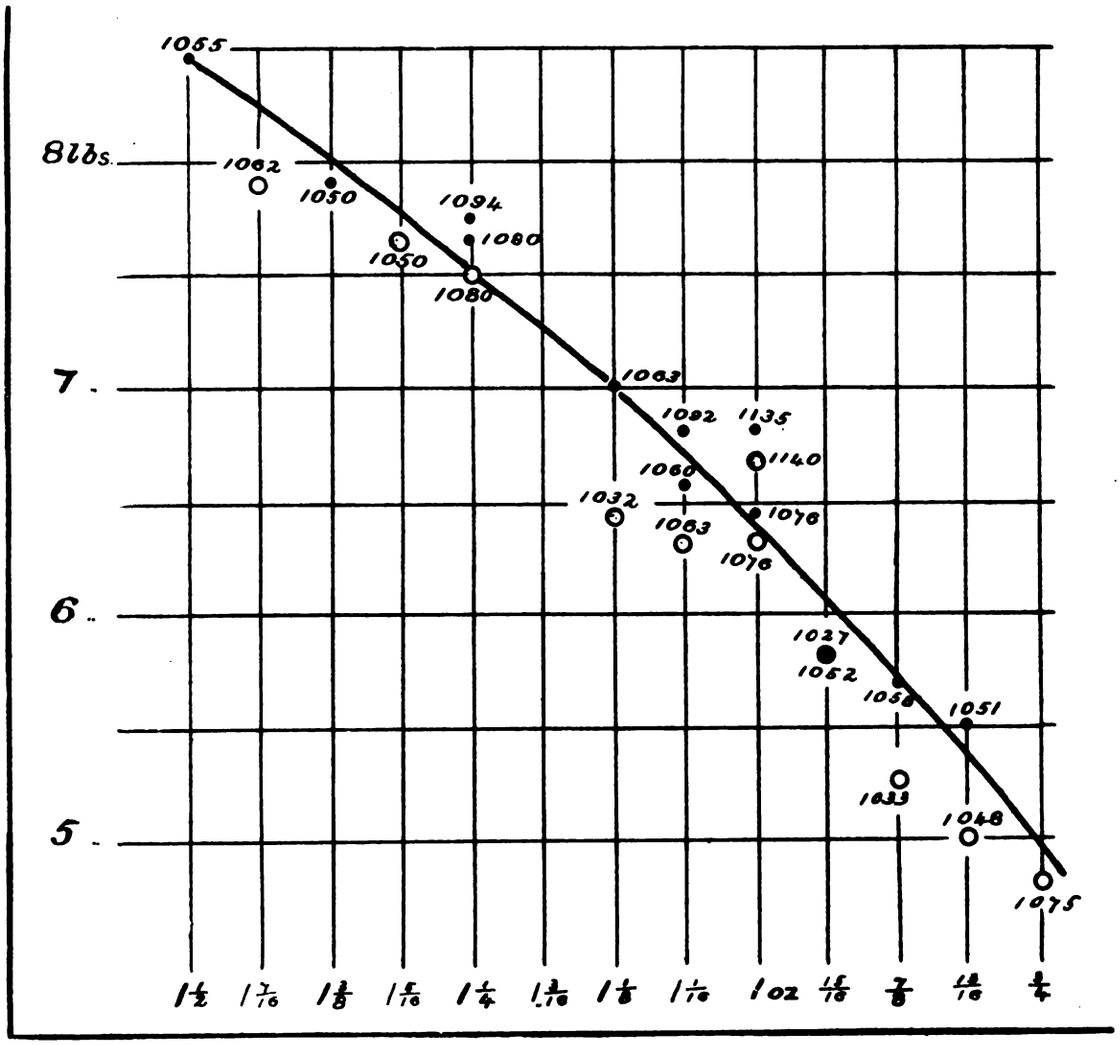
In due course it became apparent that a 16 feet-per-second rate of recoil movement, could be accepted as general standard for shot guns. The adoption of a standard value of recoil provides a basis for judging whether a measured velocity of recoil is high or low for any given gun. On the other hand it breaks down entirely if one wishes to know what excess of recoil over the accepted standard, gives an unpleasant sensation of recoil and conversely what reduction will give the shooter the benefit of a low recoil. The difficulty in fact is that one cannot think in feet-per-second. The question of shot velocities is quite different. The shooter has been given to understand that his cartridges must have a certain velocity to give sufficient penetration; and he is constantly applying a penetration test by observing the results of his shooting. In the case of recoil the many alternative loads, all giving their own particular kick, make it a question not of maintaining a particular standard, accepted and followed by the manufacturer and loader, but rather of marking personal choice from a bewildering array of combinations and compromises.

By adopting the already mentioned 16 f. s. rate of recoil movement, the velocity aspect of the measurements sinks into the background, and actual results take the form of showing what weight a gun must be to give this rate of recoil with any particular cartridge. Such is the outcome of two or more years of careful experimentation and theorising on recoil. The shooter can think in gun weight, because he has in his time tried many guns, and the one he likes best is the lightest, that gives efficient results and a moderate recoil.

A large number of recoil measurements under the new conditions have been made during the past year or two, so that there is now available a fairly complete series of values for all shot charges, from the 1½oz. of a 12in. bore magnum firing 3in. cartridges, to ¾oz. the charge associated with 20-bore guns. Both the Journée and the Houseman systems are represented in the available results, but whether the readings were originally inches of movement by the 50lbs. pendulum gun or the velocity of a freely suspended shoulder gun, the figures now submitted are in the form of gun weight for giving the standard 16 f.s. rate of recoil movement. The whole of the values which are available are set out in the table which follows:—

Shot Charge.	42-Grain Powders.				88-Grain Powders.			
	Powder.	Shot Velocity.	Gun Weight.		Powder.	Shot Velocity.	Gun Weight.	
ozs.	grs.	f.s.	lbs.	ozs.	grs.	f.s.	lbs.	ozs.
1½	52	1,055	8	8				
1 7/16					44	1,062	7	14
1⅜	47	1,050	7	14				
1 5/16					40	1,050	7	10
1¼	47	1,080	7	10	40	1,080	7	8
1⅛	42	1,063	7	0	33	1,032	6	7
1 1/16	42	1,092	6	13	33	1,063	6	5
,,	40	1,060	6	9				
1	42	1,135	6	13	33	1,076	6	5
,,					36	1,140	6	11
15/16	36	1,027	5	13	30	1,052	5	13
⅞	36	1,058	5	11	28	1,033	5	4
13/16	36	1,051	5	9	28	1,048	5	0
¾					28	1,075	4	13

The essential items in the above table are the columns showing the appropriate weight of gun, for the descending scale of shot charges from 1½ down to three-quarters of an ounce. The 42 grain class of powder gives more recoil when propelling the same quantity of shot at the same velocity than powders of the 33 grain class. Where comparisons can be made the number of ounces difference will not be found a constant quantity, but whatever the explanation may be, the general tendency is well defined. However carefully the tablulated results are examined it is quite impossible to gain any general appreciation of the relation that exists between the shot charge and the



the gun weight until the figures are set out in the form of a diagram. This has been carried out in the accompanying illustration which has been drawn to reduced scale from the original drawing on squared paper. The vertical measurements represent gun weights, whilst horizontal distances show ounces of shot. Thus, to set down the relation 7lbs. of gun weight to $1\frac{1}{8}$ oz. of shot, a spot is made at the interception of the 7lb. line on the one scale and the $1\frac{1}{8}$ oz. line on the other. Values derived from the recoil of 42 grain powders are shown by a small black spot, whilst those depicting 33-grain behaviour are shown by a circle.

When the whole of the results had been set out in the form of dots and circles, it was found that they formed a fairly consistent curve. Had every velocity been exactly 1050 f. s. the marks would have been very much closer to the mean curve which has been drawn. But velocity varies, and with it recoil. Hence the need, as shown in the table, for full weight guns when light shot charges are propelled with very high velocity. The mean curve thus lays down the weight of gun which gives 16 f. s. rate of recoil for shot charges, having the usual 1050 f. s. velocity. The weight of a 12 bore or any other gun is thus fixed by the recoil of a charge giving a 1050 f. s. velocity. If the charge of shot is reduced, the recoil certainly goes down a little, but the custom of retaining the ordinary powder charge in the presence of light loads of shot brings into force a compensating factor. That is to say when the amount of shot is reduced, velocity is increased, sometimes to such an extent that there is no appreciable diminution of recoil. If the powder charge were diminished in the same proportion as the shot, so as to retain the original velocity, each sixteenth ounce of reduction shot would permit a reduction of from four to five ounces of gun weight. With constant powder charges the allowable change of gun weight is not more than a couple of ounces.

Adopting 7lbs. as the proper weight for a gun firing $1\frac{1}{8}$oz. charges, or $6\frac{3}{4}$lbs. for $1\frac{1}{16}$oz., values which cannot well be questioned, simple division will show that each 16th ounce of shot is balanced by about 6oz. of weight in the gun. This is not in harmony with the well-known rule that a sixteenth reduction in the shot charge permits at most 4oz. change in the weight of the gun. The explana-

tion is that a large part of the recoil of a gun is due to the powder charge. The proportion is such that about two pounds of the weight of a 12-bore gun, must be taken as balancing the recoil of the powder charge, the remaining 5lbs. or 80oz. thus balancing the shot charge. This gives 4½oz. of gun per sixteenth ounce of shot.

More important perhaps than any of the foregoing considerations, is the following table of values which shows the general relation which exists between the shot charge and gun weight. The values have been taken from the mean curve passing through the various observation points shown on the diagram.

Charge of Shot.	Proportional Gun Weight.	*Difference.*
1½ oz.	8 lbs. 7 ozs.	3
1 7/16 ,,	8 ,, 4 ,,	4
1⅜ ,,	8 ,, 0 ,,	4
1 5/16 ,,	7 ,, 12 ,,	4
1¼ ,,	7 ,, 8 ,,	4
1 3/16 ,,	7 ,, 4 ,,	4
1⅛ ,,	7 ,, 0 ,,	5
1 1/16 ,,	6 ,, 11 ,,	5
1 ,,	6 ,, 6 ,,	6
15/16 ,,	6 ,, 0 ,,	5
⅞ ,,	5 ,, 11 ,,	5
13/16 ,,	5 ,, 6 ,,	5
¾ ,,	5 ,, 1 ,,	

This table shows that velocity must be the right way of expressing recoil, since a carefully chosen standard rate of movement is convertible into a series of gun weights which closely agree with practical ideas. With the larger shot charges the shooter would, for his own convenience, use guns of lighter weight than those specified, because human endurance is limited, and the weight to be carried and lifted must be taken into account. Conversely with the lightest charges on the list it is probable that the shooter might sanction rather larger weights than those given. The difference here is, however, immaterial. Taking for instance 13/16 oz. as the usual 20-bore charge, this shows a gun weight of 5lbs. 6oz. whereas 5½lbs., the usual weight for a 20-bore gun, is only 2 oz. more. The ¾ oz. charge is a fairly light load for a 20-bore; consequently the 7 oz. difference between the actual and the table value for the weight of the gun merely illustrates the low recoil, which the shooter would expect.

APPLICATIONS FOR PATENTS.

NOVEMBER 18—DECEMBER 14, 1907.

19,565a* Safety Explosives. G. Schultze.
25,549. Ammunition Hoisting for Ordnance. A. T. Dawson and J. Horne.
25,742.* Steel for Armour Plates, Projectiles, etc. Compagnie des Forges et Aciéries de la Marine et d'Homécourt. (French application September 7, 1907).
25,828.* Projectile Fuses. K. Völler.
25,939. Air Guns. G. F. Urry.
26,025. Projectiles. W. J. Douglass.
26,088. Drop-down Ejector Small Arms. F. S. Cox.
26,129.* Ammunition Waggons. Fried Krupp, A.-G. (German application February 20, 1907).
26,141. Range Keepers for Guns. A. T. Dawson and J. Horne.
26,261.* Explosives. P. Winand. (German application December 6, 1906).
26,380. Safety Catch and Locking Bolt for Rifles. Major W. B. Wallace.
26,434. Mining Cartridges. C. Stuart-Bailey.
26,438. Explosive Shells. F. M. Hale.
26,447.* Coupling of Guns. S. M. Walker.
26,515.* Projectiles. Fried Krupp, A.-G. (German application March 9, 1907).
26,546. Telemeters. O. Eppenstein.
26,549. Targets. E. A. Evans and T. Coley.
26,635. Firearms. E. R. Tufts.
26,718. Apparatus for the Training of Gunpointers. N. Pogolski.
26,791.* Explosive Substance. W. S. Winchester. (United States application December 4, 1906).
26,802. Cartridge Wads. W. Jones.
26,823. Explosives. South African Maganite Explosives Syn., Ld., and H. C. L. Bloxam.
26,913. Apparatus for use in Revolver Instruction. W. S. Simpson.
26,943. Sights for Small Arms. Birmingham Small Arms Co., Ld., A. H. M. Driver, and G. Norman.
26,962. Small Arms Cartridge Holder. E. H. Parsons.
27,000.* Targets. G. Schupp and G. Weingärtner.
27,065.* Anson-Deley Gun-lock-action. H. L. England.
27,078.* Ammunition Vehicles. Fried Krupp, A.-G. (German application February 23, 1907).
27,079.* Sighting Attachments for Ordnance. Fried Krupp, A.-G. (German application February 28, 1907).
27,182. Lee-Enfield Rifle. A. W. Rogers.
27,231. Rotary Match Target. G. Tyer.
27,272.* Artillery Vehicle Wheels. Fried Krupp, A.-G. (German application March 2, 1907).
27,273.* Percussion Fuses. Fried Krupp, A.-G. (German application, March 23, 1907).
27,296.* Sights. P. Jensen.
27,297.* Sights. P. Jensen.
27,442.* Ordnance Breech Mechanism. Fried Krupp, A.-G. (German application April 10, 1907).
27,635.* Windgauge for Firearms. A. Russell.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

NOVEMBER 28—DECEMBER 19, 1907.

COMPILED BY HENRY TARRANT.

25,030 (1906). **New Form of Projectile and Gun.** E. Noack, Germany. This projectile is disc-shaped and is provided on its edge with oblique slits. The gun barrel is rectangular in section and an enlargement at the muzzle allows the gases to reach the projectile and revolve it on its shorter axis by entering the oblique slits. The circular saw action of this projectile is claimed as an advantage. A number of barrels are arranged side by side. Accepted Nov. 7, 1907.

26,813 (1906). **Range Finders.** A. J. Boult, London (Agent for *Société Ponthers and Therrode, Paris*). Improvements are described in this specification in that type of range finder which is provided with an angular micrometer with a telemetric drum having a graphic diagram enabling the distance of the object to be easily read off. The telemeter also has an improved arrangement of the twin telescopes through which the two eyes of the observer see the object. Accepted Nov. 26, 1907.

26,859 (1906). **Magazine for Military Rifles.** T. H. Matthews, and J. Mues, Melbourne. The cartridge platform of a magazine for rifles is connected with a spring and lever arrangement in such a way that it can be drawn down to the bottom of the magazine to facilitate loading by means of a little lever lying on the outside of the magazine. Accepted Nov. 21, 1907.

26,960 (1906). **Howitzer Sighting Apparatus.** Lieut. A. T. Dawson and G. T. Buckham, London. Sighting apparatus for ordnance firing at high angles in which elevation is affected by means of an elevating arm arranged on the trunnion arm at one side of the cradle and in which the arm is actuated by elevating gear or by the gear for causing the gun to move quickly to or from its loading position. Accepted Nov. 27, 1907.

27,115 (1906). **Percussion Fuse Mechanism.** C. Puff, Germany. The arrangement of parts in this percussion fuse is intended to provide for consistent action of a retarding device. For this purpose the locking means, which hold the firing pin until the time of impact when immediate discharge is required, are displaced so that the ignition parts are exposed to spring pressure after release to retard the detonation. Accepted Nov. 14, 1907.

28,732 (1906). **Mounting for Field Ordnance.** W. Beardmore & Co., and A. Bremberg, Glasgow. In order to allow mountain guns to be used and easily manipulated in the high angle position, the trail is made in two parts, the forward part carrying the gun, cradle, and training gear, the back part being the trail proper. The forward part is adapted to abut either on the vertical face of the trail for ordinary firing, or on its horizontal upper surface for high angle firing. Accepted Nov. 21, 1907.

29,221 (1906). **Automatic Pistol Mechanism.** J. Carter and F. T. Murray. The automatic pistol evolved by these two patentees which has been dealt with in these columns is improved in several respects to render it more compact and to enable it to be very easily dismounted and assembled. Accepted Nov. 28, 1907.

29,689 (1906). **Dismountable Ordnance.** A. Bremberg, Glasgow. In order to render mountain guns easily dismemberable the part containing the breech block and firing apparatus is made separate from the barrel and chamber portion. The inventor improves this construction by providing washers which may be inserted between the seating, against which the cartridge base lies, and the breech block proper. Relative movement or "set" between the barrel and breech parts may thus be compensated. Accepted Nov. 7, 1907.

29,724 (1906). **Cartridge Holders.** C. J. Ross, Exeter. In patent No. 20,634, 1906, the inventor described a pocket cartridge holder. The "cylindrical delivery bottom" of this device is now eliminated because it is heavy and expensive and a curved spring lower portion is introduced where from the lowermost cartridge may be easily removed by finger and thumb pressure. Accepted Nov. 7, 1907.

1,104 (1907). **Shot Hole Gauge for Targets.** A. A. Canell, London. On a transparent piece of material such as celluloid, rings are marked corresponding to the outside edge of the bull and to those of the target to be gauged. Circles the exact size of the shot hole are marked with their edges either touching these lines or with the centres on the lines according to which system of marking is to be judged so that when the celluloid is laid properly on the target face it may easily be seen whether the actual shot either cuts or has its centre inside either of the lines or the ring representing the edge of the bull. Accepted Nov. 28, 1907.

3,319 (1907). **Device for Teaching Aiming.** G. Collins, Manchester. Two correspondingly shaped supports for two rifles are so arranged that when one rifle is moved in aiming the other exactly follows its movements. The instructor is enabled to watch the aiming efforts of a novice and to correct any faults he may have. Accepted Nov. 28, 1907.

3,605 (1907). **Sighting of Ordnance.** A. T. Dawson, and G. T. Buckham, London. Sighting apparatus of the kind set out in patent No. 673, 1907 in which the pointer, instead of being stationary, as in the ordinary sighting apparatus provided with a hand-actuated dial, is made capable of angular adjustment about the axis of the dial by means of a calibrating device that receives its motion from a spiral cam formed in or on the range dial. Accepted Nov. 7, 1907.

3,690 (1907). **Sighting of Ordnance.** A. F. Petch, London. To obviate certain disadvantages sights on each side of the gun in certain sighting gear are made independent of each other for movements in elevation, but they are cross-connected for deflection in such a manner that relative movements of the sights in elevation do not affect the angle of deflection. Accepted Nov. 21, 1907.

4,349 (1907). **Improvements Relating to the Control of Ordnance.** Sir P. Scott and A. T. Dawson, London. (*This Specification is a Secret Document*).

4,688 (1907). **Ordnance Sights.** E. L. Zaliuski and J. L. Rice. A collimating sight is connected with the primary telescopic sight or range finder so that when the latter is raised the former is correspondingly depressed and *vice versa*. The primary sight is used for training the gun transversely and the collimating sight for elevation. Accepted Nov. 28, 1907.

4,823F (1907). **Automatic Rifle Locking Apparatus.** P. Mauser, Germany. To simplify the bolt lock and to ensure prompt locking, a U-shaped part which rocks with a cradle-like action is introduced into the Mauser automatic rifle. The top of this part forms a support for the bolt and the side arms projections are arranged in conjunction with cavities in the breech path to effect the compulsory rocking of the locking part. Accepted Nov. 28, 1907.

4,824 (1907). **Magazine for Air Rifles.** J. H. Cox, Birmingham. (*See Selected Patents*).

5,355 (1907). **Adjustable Foresight for Rifles.** E. J. D. Newitt, London. (*See Selected Patents*).

7,722 (1907). **Short Base Range Finders.** H. R. Taylor, York. In specification No. 12,735, 1904, the patentee described the construction of a short base range finder. He now points out certain objections and his method of obviating them. Accepted Nov. 21, 1907.

7,414 (1907). **Recording Targets for Miniature Ranges.** J. S. Crowley, London, and H. R. Sanders, Bexhill-on-Sea. Behind an ordinary card target is arranged a band of paper or canvas. This band runs round rollers and is given an intermittent movement so that each shot may be recorded. A metal screen protects the frame on which the band works. Accepted Nov. 21, 1907.

7,838 (1907). **Improved Safety Explosive.** W. Ceipek, Vienna. An explosive which it is claimed has great stability and a high degree of safety during manufacture and handling is composed of a mixture of ammonium nitrate and tumeric-charcoal. With from one to six per cent of tumeric-charcoal the explosive is safe in an inflammable atmosphere, but the fire damp safety decreases as the carbon contents increase. With 12 per cent of tumeric-charcoal the explosive attains its maximum power. The tumeric charcoal is prepared by carbonising powdered tumeric root. The explosive can only be exploded by a detonating cap. Trinitrophenol or trinitrotoluene may be added to enhance the explosive power. Accepted Nov. 7, 1907.

9,820 (1907). **Firing Mechanism of Ordnance.** Fried. Krupp, A.-G., Germany. To increase the rate of firing of automatic ordnance with slip lock or single motion cocking and firing mechanism an arrangement is provided whereby the firing mechanism is automatically transferred into a locked position before the breech is closed and is released by the automatic unlocking effected by the closing of the breech block. Accepted Nov. 28, 1907.

12,351 (1907). **Attachment of Rifle Barrels to Bodies of falling Block Actions.** H. W. Lake, London. (Agent for *Winchester Arms Co., U.S.A.*). (*See Selected Patents*).

12,667 (1907). **Travelling Target Apparatus.** J. E. and H. W. Whitehouse, Oakham. A cheap and simple form of travelling target apparatus is dealt with in this patent. Two large wheels, one at the firing point and the other at the butts, carry an endless wire to which is attached a horizontal travelling target holder. The holder is moved from firing point to butts or *vice versa* by turning the wheel at the firing point. Accepted Nov. 7, 1907.

15,760 (1907). **Anchor Spade for Ordnance.** Fried. Krupp, A. G., Germany. To adapt the spade of ordnance either for hard or soft ground it is constructed so that its surface can be increased in area. In at least two operative positions it may be rigidly connected to the gun carriage. Accepted Nov. 13, 1907.

21,217 (1907). **Automatic Firearm Mechanism.** R. Fromnier, Hungary. In Patent No. 20,362, 1901, this inventor described two catches for holding the breech block of a automatic arm in its rearward position. To ensure correct working of these catches (which is so essential) he arranges that they may easily be removed to allow their springs to be correctly set. Accepted Nov. 21, 1907.

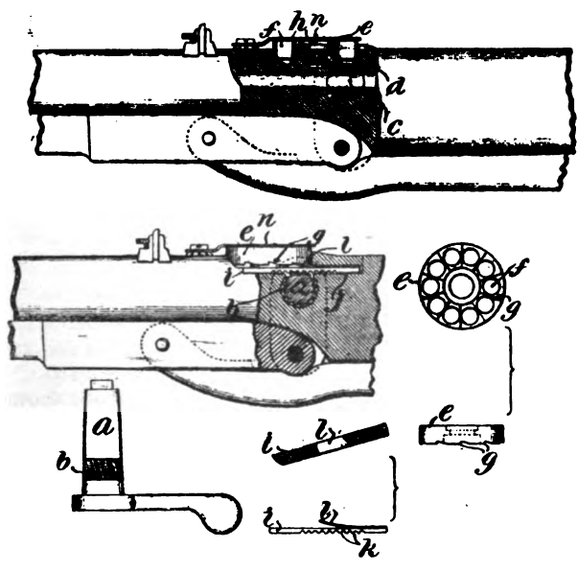
22,288 (1907). **Attachment for Revolvers.** H. Renfors, Finland. In patent No. 26,611, (1906) a walking stick attachment for revolvers was described. The present invention allows of a collapsable tube to be attached to the butt of a pistol. This tube takes the place of a stick, is used as a help in aiming and is closed up when the pistol is to be carried in the pocket. Accepted Nov. 28, 1907.

SELECTED PATENTS.

MAGAZINE FOR FIXED BARREL AIR RIFLES.

4,824 (1907). J. H. Cox, Birmingham. In this specification is described a magazine for "B.S.A." air rifles of the fixed barrel pattern. The magazine attachment calls for no material change in the present construction of the rifle and is operated by the rotating movement of the ordinary loading plug.

Referring to the accompanying illustration, the loading plug *a* is constructed and fitted to the breech in the ordinary way, except that the teeth *b* are cut upon the body of the plug as is shown in drawing in detail. The plug has the usual pellet receiving and positioning hole *c* and the top of the rifle body immediately over the centre of the plug has the usual loading hole *d*. The plate *e* is provided with a number of holes or pellet compartments *f*, and on its underside are the rachet teeth *g*, which correspond in number with the compartments *f*. This plate is let into the top of the rifle body and is firmly held, although not against rotary movement, by the shouldered pin *h*. Beneath the plate is arranged the bar *i* which works in a groove *j* in the body and is provided with the rack teeth *k* adapted to engage the teeth *b* cut on the plug *a*.

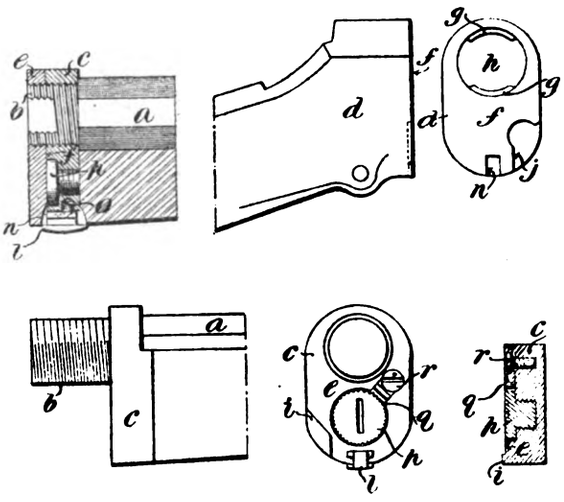


When this arrangement is clearly understood it will be obvious that the rod will be moved backwards or forwards when the loading plug *a* is turned up to allow a pellet to be inserted in its passage *c* or back to its firing position. This movement is utilized for automatically turning the magazine plate on its pivot *h* by arranging that the spring pawl *l* on the top of the bar *i* shall engage behind one of the rachet teeth *g* cut in the underside of the magazine plate. Every time, therefore, that the loading plug *a* is rotated to turn the hole *c* up at right angles with the barrel to the loading position, the magazine plate is pushed round by the pawl *l*, a sufficient distance to bring the next pellet compartment *f* immediately above the hole *c*. This movement is repeated every time it is desired to reload the rifle, a pellet dropping out of one of the compartments *f* and entering the pellet receiving hole *c* in the plug by its own weight. The plug is turned back to its original position and the rifle is ready for discharge.

The cover *n* is stiffly fitted to the rifle body so that it may be turned over to cover the magazine top to prevent the pellets from dropping out. Accepted October 31, 1907.

BARREL AND BREECH ATTACHMENT FOR RIFLES.

12,351 (1907). H. W. Lake, London. (Agent for the *Winchester Repeating Arms Co., U.S.A.*). The object of this invention is to simplify the attachment of rifle barrels and actions of the falling block type to render manipulation easy and to provide for adjustment to take up wear.



From the drawings appended it will be seen that the barrel *a* is provided with the extension *b* which projects from the part *c* on the rear end of the barrel. The part *c*—or "receiver extension" as it is called—conforms in shape to the cross sectional form of the front end of the receiver or action body *d*, and is virtually an extension of the body. The rear face *e* of the receiver extension *c* bears directly on the correspondingly shaped front face *f* of the receiver *d*. This arrangement it is claimed, largely removes the strain and shock of firing from the interrupted screw threads formed on the part *b* of the barrel which engages correspondingly interrupted threads *g* in the reception hole *h* formed in the action body *d*.

In order that the barrel shall be brought into exact position when the threads of the rear part *b* of the barrel and of the body hole *h* draw the receiver extension face *e* close up against the face *f* of the body, the stop shoulder *i* on the barrel end is adapted to bear against the straight surface *j* of the body. When the barrel and body are thus brought into exact registration, they are locked against rotary movement in relation one with the other by the sliding portion *k* the front nose *l* of which is pushed forward to engage the recess *n* in the bottom of the face *f* of the receiver extension *d*. The locking slide is held in either of its two positions by the little spring actuated plunger *o*.

For the purpose of taking up any wear of the bearing faces *e* and *f*, the large-headed screw is fitted directly below the barrel centre in the receiver extension *c*. Its perifery is knurled so that the teeth of the screw held "dog" *q* may hold it securely in any position. Should it be necessary to take up any wear the small screw *s* is released, the dog *q* is pushed away from

the screw *p* and the last named is turned outwards so that its head is made to stand away from the face *e* to take up the play which is caused by removal of metal from the faces *e* and *f* through wear. Accepted November 14, 1907.

AN ADJUSTABLE FORESIGHT FOR RIFLES.

5,355 (1907). E. J. D. Newitt, London. This invention relates to an improved fore-sight for a gun, of the type in which an aperture is provided at the muzzle end, the centre of the area of which is indicated by a sighting bead or the extremity thereof, which will, in the correct aim of the gun, be in the line between the object aimed at and the backsight, the boundary wall of the aperture being as thin and unobscuring of the field of view as considerations of strength and durability will permit. For rapid firing, at relatively short range, the internal profile of the aperture alone may be the criterion of correct aim, the gun being so directed that the profile is caused to frame an apparent picture of the object aimed at.

According to this invention, the sighting bead employed for longer range firing as a more exact criterion is provided by the lower pointed extremity of a wire or thin strip which is attached to and carried by the crown of the boundary wall of the before mentioned aperture, the pointed extremity being in the geometrical centre of the aperture both vertically and horizontally, or the wire or strip being so mounted on the crown of the boundary wall of the aperture as to permit, to an indicated degree, the transverse displacement of its depending extremity relatively to the aperture to allow for the drift of the projectile due to the rifling, for wind or other circumstance which may require the deviation of the axis of the bore from the line of sight to enable the projectile to hit the object aimed at.

The bounding surface of the aperture may be short or long, as measured in the direction of aim and, according to a further feature of this invention, if of such length as to adequately protect from injury the depending sighting wire or strip, it will be advantageous to make the boundary wall slightly divergent so that it may obscure the field of view to the minimum amount due to the unavoidable thickness of the boundary wall.

To permit of transverse adjustment of the depending sight it may be secured eccentrically on a carrier adjustably mounted in the crown of the boundary wall of the aperture so that on rotating the carrier the lower extremity of the sight will be displaced sideways in one direction or the other as desired. The aperture frame as above described may be made of thin tempered steel arranged to be separably secured to the muzzle by a clamping screw.

The depending fore-sight is in the first instance intended to be used in conjunction with an aperture back-sight, but in consequence of the clear space beneath its extremity, it may also be used in combination with the ordinary V-notch form of back-sight and is intended to constitute means for true aiming claimed to be greatly superior to the combination consisting of a V-shaped back-sight and an upstanding fore-sight: for in this latter combination the true aim is arrived at when the fore-sight is very nearly obscured by the back-sight requiring an adjustment of the gun which is very difficult of accomplishment. Moreover an alteration of the elevation is caused when more or less of the fore-sight is obscured, whereas by the improved combination the true aim will be arrived at when the fore-sight is not at all obscured by the back-sight and there is a minimum interval for the passage between them of the imaginary line of sight from eye to object aimed at.

The sight, as is shown in the drawings here reproduced, is adapted to be secured to the barrel of the rifle *a* by means of the socket *b*, the correct position of the sight being maintained by the screw *c*. For double-barrelled rifles the sight is arranged so that it may be fixed to the rib *d* between the barrels by screws *e* (Fig. 5). To enable the depending wire *f* to be transversely adjusted, it is eccentrically secured to a rotatably mounted carrier *g* adapted to be angularly displaced by a screw driver. The carrier *g* is secured in the crown of the sleeve *h* by means of a screw which attaches it to another conical edged disc inserted from beneath in the lower portion of the doubly countersunk hole in the sleeve. An alternative form of attachment is shown in Fig. 5 where the sight carrying part is held in place by the plate *i*.

When the sighting wire *f* is in the central position, the notch in the top of the rotatably-mounted carrier *g* registers with the index mark *j* on the sleeve in front of the carrier. Index marks are provided on either side of this central line. It is to be noticed that the wire *f* turns through an arc at the rear of the

Fig. 1

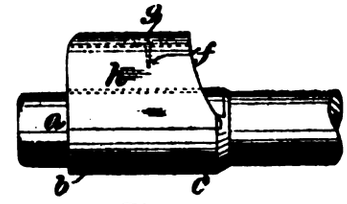


Fig. 2

Fig. 4

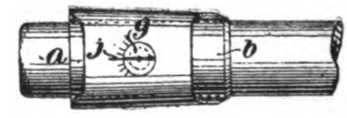


Fig. 3

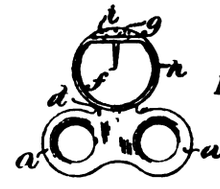


Fig. 5

centre of the aperture, and adjustments to allow for deviation have therefore to be made in a direction opposed to that of the error.

The patentee points out that he has knowledge of Patent No. 1,995, 1900 in which a pointed extremity consisting of a depending wire mounted on a rotatable spindle, is used in a telescopic sight. He wishes it to be understood that his invention as is shown clearly in the claims here reproduced relate only to fore-sights in which an aperture is provided on the muzzle of the fire arm.

1. A fore-sight for a fire-arm comprising a thin wall enclosing an aperture, in which the precise line of sight traversing the aperture is indicated by the lower extremity of a wire depending from the crown of the boundary of the aperture.

2. A fore-sight according to Claim 1, in which the depending wire is capable of transverse adjustment with respect to the centre of area of the aperture.

3. A fore-sight according to Claim 2, in which, for the purpose of transverse adjustment, the depending wire is secured eccentrically to a rotatable carrier mounted in the crown of the boundary of the aperture.

4. An aperture fore-sight in which the boundary wall of the aperture diverges in the direction from the eye of the marksman using the fire-arm. Accepted Nov. 7, 1907.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 185.—Vol. XVI. FEBRUARY, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

The Accident at Dyke's.—One cannot help feeling that the explosion which occurred at a City cartridge warehouse may indirectly produce serious results for those who carry on cartridge filling in retail premises. Hitherto it has been possible to answer all alarmist criticism and complaints against existing methods by pointing out that nitro-powders which are so much safer than black, have never caused an explosion. Whatever may have been the cause of the recent explosion, the City coroner, with the help of Captain M. B. Lloyd, is conducting a very careful enquiry into the whole of the circumstances of the accident. There seems to be no doubt that two explosions occurred with a short interval of time between them, and the possibility of one of them having been caused by gas is being carefully considered. The coroner's jury are of course certain to add some kind of rider to their verdict; and its general substance can be foretold with a fair degree of certainty. The full and final judgment must, however, come from Captain Lloyd's report to the Home Secretary. The view which he takes is the one of greatest importance to the trade. Gunmakers and others who fill cartridges in London have earned high praise for the care with which they carry out the requirements of the Act; and if the explosives department finds that the recent accident discloses no new or hitherto unsuspected source of danger the troubles of gunmakers will probably not be increased by further restrictions on the method of working. One cannot, however, ignore the possibility that an accident of this kind, however caused and in its effects no more serious than an ordinary fire or ordinary gas explosion, may provide the text for an alarmist agitation against cartridge filling. Here again, however, the inspectors must be convinced of the need for change before any proposed alteration of existing law could be seriously entertained.. The only practical policy to adopt is to wait with all patience for Captain Lloyd's report.

The Miniature Bisley Meeting.—From actual observations on the spot it is overwhelmingly clear that the National Rifle Association were ill-advised, and committed a serious error of judgment, in disqualifying the War Office miniature rifle from all the leading individual competitions at their meeting. It is absolutely immaterial whether the Astor trustees are or are not responsible for the decision that the funds of the trust could not be devoted to competitions with rifles weighing less than 8lbs. The actual situation which exists makes it seem probable that the National Rifle Association decided to exclude the War Office miniature rifle, and then asked the Astor trustees to take the responsibility for the decision upon their own shoulders by declaring the use of light rifles to be contrary to the trust. This view finds every support in a letter which Mr. Coode-Adams, Mr. Astor's representative, published in the *Pall Mall Gazette*. He said that the trustees were bound by every rule of law and honour not to devote the funds placed at their disposal to a purpose lying outside the object laid down in the deed of trust. Highly coloured language of this description generally covers a flaw in the argument, and one cannot help asking why, if honour had so large a share in the arrangements for the recent meeting, its promptings were entirely disregarded in 1906, when the War Office miniature rifle was freely authorised and its use actually encouraged. It would be ungracious to pursue a matter of this kind to its ultimate conclusion were

there not a good purpose to serve. The National Rifle Association lies under suspicion of having done more than merely acquiesce in the disqualification of the War Office rifle. It may have honestly believed that a heavy-weight rifle gives a closer approach to military conditions of shooting than a light miniature rifle. This is in fact the firm belief of everyone with any practical acquaintance of the subject. On the other hand the larger and heavier rifle is also the more accurate target weapon, and shooters ought in justice to have been allowed to use both rifles indiscriminately, whereby the change to military weights would have been gradually effected and not rushed by the artificial embargo which has been laid down. In fact the whole question boils down to an error of judgment, for which the Committee of Management of the Miniature Bisley Meeting must be held responsible. In this connection it is impossible to peruse the names of this so-called committee of management without asking oneself whether they have really taken any responsible part in making the arrangements for the meeting. It has been self-evident that the committee of management have, with very few exceptions, taken no part whatever in the management of the meeting. If the committee work preceding the meeting has been similarly neglected it is not surprising that mistakes of policy should have been sanctioned in the absence of proper discussion. Colonel Crosse, the secretary, has, by herculean labour, achieved a remarkable success, but it is only fair to point out that he ought to have a better committee to support his efforts. The present members might be promoted to an entirely ornamental grade, and be replaced by active workers drawn from the leading clubs.

Sir F. L. Nathan's Lecture. — Particular interest is being taken in the lecture which Sir F. L. Nathan has arranged to deliver on Monday the 3rd inst. at the Society of Chemical Industry. The lecturer occupies an entirely unique position in the manufacture of explosives. Unlike most military officers he has been relieved from the stupid rule necessitating a periodic interruption of his staff duties in order to rejoin his regiment. The uninterrrupted years of labour which he has devoted to the work of the Waltham Abbey factory have been super-added to special qualities which have made him an exceptionally fit person for the responsible, and at times dangerous, work which has fallen to his lot. Those who know him best speak of him as a man whose entire life and thoughts are centred on the Waltham Abbey factory. He is a man of remarkable physical activity, and his walking powers are well tested by the daily round of inspection, which enables him to keep in close touch with every single detail of the factory's work. His business ability has enabled him to build up a system of records and accounts by which every detail of administration can be checked and supervised. This sketch merely covers Sir F. L. Nathan's ability as a factory superintendent. It therefore, leaves untouched the technical details of his labours, and one has only to enquire from chemists who have been thoroughly trained in explosives to find that the superintendent at Waltham Abbey is an expert of the highest rank amongst experts. The practical achievements of the Waltham Abbey factory comprise within recent years radical and almost revolutionary changes in the methods of manufacturing guncotton and nitroglycerine. The acid plant is also worked upon a system which contains several original and useful ideas. These modifications of process have not in any instance been brought about by a desire for change, or the wish to cultivate originality. Their adoption has been decided on commercial motives alone, and the Waltham Abbey factory studies cost sheets as diligently as any commercial concern with dividends to pay. The paper, which is the joint work of Sir. F. L. Nathan and Mr. William Rintoul, after dealing with the discovery and early history of nitroglycerine, will describe the various plants which have been used in its production on a manufacturing scale, the modern plants and processes being dealt with in some detail. There is also a section devoted to the composition of the nitrating acids and their proportion in relation to the glycerine, and to yields of nitroglycerine.

Our Article on Recoil. — Some apology seems necessary for again taking up the subject of recoil. The justification must be that this is one of the few measurable characteristics of a gun, which has never been reduced to a thoroughly practical basis. Small arms are more easily dealt with experimentally than artillery, and it must be assumed that this explains why artillery text books so completely fail to make clear the very simple mathematical basis upon which the recoil of a gun can be calculated. Looking back on the apparatus which has been used within the past ten years for measuring recoil one cannot help feeling struck by the apparent perversity with which the most difficult methods are adopted to the exclusion of the more simple ones. Within the past year or two the system of measuring the recoil of small arms, by chronographically recording the rate of recoil of a freely suspended gun, has been reduced to so simple a basis that a considerable number of exact statistics of actual behaviour have been collected. These provide a means for determining constants, and generally examining the theory of recoil. It immediately becomes apparent that recoil should not be regarded from the point of view of motion produced by gas pressure acting against the gun, but rather that pressure should remain a factor in the production of shot velocity, and that recoil should be approached entirely from the point of view of the velocity of the products ejected from the gun. This frees the consideration of recoil from the abstruse theoretical considerations which concern merely the propulsion of the shot. If the theory of pressure and expansion is duly harmonised with the motion of the shot along the bore it is quite unnecessary to work out the recoil on the same basis. What is true of the shot must also be true, in due proportion, of the gun. The same journey need only be covered once, and, therefore, recoil need only be considered as a factor of shot velocity and the velocity of the powder gases which emerge from the muzzle. An attempt to demonstrate this simplified basis of treatment in respect to artillery problems is put forward in detail in this issue.

THE FUTURE OF RIFLE RANGE SHOOTING.

All classes of shooter, whether in the army, in the volunteers, or merely civilian marksmen, have been wondering what will be the ultimate result of the army order on rifle shooting, the text of which was published in the *Field* on the 4th ult. The Army Rifle Association at their annual meeting found it necessary to refer to this circular as something which affected the object, and almost the constitution, of their Association. They kissed the rod wielded by the higher authority in the true spirit of military discipline. The Army Council circular which had been issued could be obeyed with all alacrity, because the views and opinions therein expressed were also those of a majority of the members of the Army Rifle Association. The hint of dissentient voices, conveyed by the limiting term majority, is the nearest approach to a protest which the meeting dared to express. One cannot help admiring the spirit of absolute loyalty to service traditions which forces a body like the Army Rifle Association to support a policy emanating from head-quarters which is clearly not the product of anyone who possesses even an elementary knowledge of rifle shooting and all that the term conveys. The people who know least about shooting fall into the error of supposing that manifestos, framed on the lines of an election address, are necessary to ensure a high standard of proficiency. In point of fact nothing could be further from the truth. Shooting is one of the very simplest of skilled achievements, and no other recipe for perfection exists than good guns and ammunition and plenty of practice. The man who supposes that bulls-eye shooting is so much time wasted is merely endeavouring to pass a spectator's opinion on something of which he lacks personal practical acquaintance. Only the rifleman can know the rifleman's mind, and all the processes which go to the making of a good score. No exception can in fact be taken to the man who is actually engaged in shooting. This man is obtaining practice and is acquiring useful information. To say that he ought to be shooting with a shorter time limit, at a smaller or worse defined target, at an unknown range, or anyhow under conditions different, so long as they are different, is begging the whole question. Ammunition is not so cheap that it can be wastefully expended, and if in peace time it is possible to occupy fifteen minutes in the firing of seven rounds, then it stands to reason that more instruction and information has been gained from those seven rounds than if they were pumped out of the magazine in twenty seconds.

The keynote of the Army Council circular is that bulls-eye shooting leads to the paying of undue attention to trigger pressing and holding, to the exclusion of the more valuable faculty, from a military standpoint, of taking rapid aim at an object in a natural background. The whole argument turns on first principles. Rifle shooting may be divided into two clear and distinct classes; first, practice with full power ammunition at measured ranges as a means of learning the characteristics of the rifle and ammunition, and second, rapid and easy manipulation of the rifle such as can be most conveniently acquired under miniature conditions of shooting. The Army Council circular suggests that the first section, viz. ordinary target practice is useful enough for recruits in the earlier stages of tuition, but that they should very soon be transferred to an advanced stage where they fire full power ammunition over unknown ranges and at diverse marks. Rifle shooting competitions, which take the form of military manœuvres on a small scale, are all very well in their way, but the results will not bear statistical examination. If the Army Council would visit one of the London shooting schools they would be able to see for themselves how, within the compass of a ten-acre field, the sporting enthusiast is able to secure first-class practice under conditions which adequately represent ten fine sporting estates rolled into one. The pheasant covert, the grouse moor, the partridge fields and the rabbit warren are all duly reproduced, not exactly on a miniature scale, but at any rate so that the actual shooting conditions are similar. The essence of shot gun shooting is proper handling of the weapon. To acquire corresponding efficiency in handling a rifle one needs only to adopt the ·22 cartridge as a substitute for the service cartridge. This gives a scale reduction of about one in three which would govern the laying out of the military shooting school. The relation as regards cost, would be about one in ten, a matter of great importance where everything depends on unstinted supplies of ammunition.

From what has been said it should be clear that, whilst the Army Council are inspired by the desire to carry rifle shooting further than the ordinary work of the target goes, they have not sufficiently studied ways and means. Amongst the multitude of shooters there is undoubtedly wisdom, and the civilian club members would not be prevented by considerations of military etiquette from upholding their views. Bulls-eye shooting is far too well established by a long process of survival to be upset by any vexatious present day interference. The Army Council may theorise as much as it likes, but the members which compose it are not rifle shots, probably never have been, and certainly they cannot rule the opinions of the nation on a subject where the nation possesses practical information. The Army Council is evidently ignorant of the most simple elements of rifle shooting. It wishes to harmonise range shooting with practical conditions. Range shooting is practical, and the shooter who will take ten seconds to let off his rifle if ten seconds are available can let it off in half a second if occasion demands. The mere question of making a rapid estimate of range, and pointing the rifle accordingly, is one which comes best after practice at measured ranges. The deerstalker chooses for his sport the rifle with the flatest trajectory, because it minimises the unavoidable errors due to mis-estimating the range. The War Office gives the soldier a weak rifle, and by modern standards, a slow moving bullet. The finest deerstalker cannot afford to use the ·303 for 150 yards shooting when the Mannlicher is available, but the British soldier must use the service rifle, and he must correct its deficiences by acquiring an inspired grade of skill beyond ordinary human capacity.

ELEY'S MODDITE.

MESSRS. Eley Bros. Ld., have issued an interesting circular announcing the introduction of an improved form of modified cordite, from which arises the name "Moddite." They point out that it has long been recognised that Mark I. cordite, though giving satisfactory velocity results in the service cartridge, possesses the objectionable characteristic of causing great heat and erosive effects. Cordite has achieved great popularity in the past as a propellant for sporting express cartridges in spite of these defects. It possessed the virtue that it could always be relied upon to ignite readily, a quality lacking in some of the alternative explosives which have been tried and used. Moddite is put forward as an explosive which combines the virtues of cordite. from the point of view of sensitiveness to cap ignition, and of modified cordite in the strip form, otherwise known as M.D.S. cordite, in regard to insensitiveness to temperature differences. Some particulars which have been placed before us may be quoted in the present connection. Moddite has the same general composition as cordite and M.D.S. cordite. As compared with ordinary rifle cordite the charges giving standard ballistics in express rifles are nearly five per cent. less in weight. Thus 57 grains of Moddite takes the place of 60 grains of cordite. As regards the effect of temperature on pressure, results taken at 60° and 120° F. with Cordite show a difference of between 20 and 25 per cent. This means that a cartridge with a service pressure of 15 tons at 60° F. registers between 18 and 18·75 tons when the temperature is raised to 120° F. With Moddite the change is exactly that of M.D.S. cordite, viz. for the same temperature differences the rise lies between the limits of seven and ten per cent. The 15 tons service pressure can thus not exceed 16½ tons when the cartridge is fired under tropical conditions.

Moddite will, for the future, be loaded into all Eley's express and military cartridges of ·475 bore and under. The practice of loading reduced charges for use in tropical countries will not be followed with the new powder. An actual sample of Moddite which has been delivered at this office suggests that very effective chemical means have been found for obviating the brittleness of the M.D. composition, when made up into the tape form for use in small arms. The material can be tied in knots and untied, and shows no tendency to crack or chip in cutting. It can in fact be cut longitudinally with the same ease as crossways. There will thus be no loading difficulties with the new explosive. Just as ordinary cordite allows itself to be cut into bundles of strands of definite length, equal length meaning equal grains weight from the powder loading standard of accuracy, so Moddite charges may be cut off without the necessity to make a fine adjustment of the charge by a subsequent weighing process. Altogether Messrs. Eley Bros. deserve every congratulation for having introduced a change of explosive which will emphasise the out of date characteristics of ordinary cordite. Moddite is of course applicable to all bores of military cartridge, and the reduction of the temperature variation to an amount which may be ignored represents a valuable advance without the attendant disadvantages which are known to exist with M.D.S. cordite.

RECOIL CALCULATIONS FOR ARTILLERY.

ONE cannot help coming to the conclusion that most of the text books on gunnery fail to make clear to the student the exact relation which exists between the recoil of a gun and the expulsion of the charge therefrom. Reference is made to recoil in its simplest aspect, viz., the actual value of the backward movement produced, without reference to its absorption by the gun carriage and other incidentals of construction. *The Text Book of Gunnery*, in this as in most other matters, contains large quantities of mathematical demonstration with a very small proportion of explanatory matter. The following extract shows how briefly the subject is dismissed :—

"It is found practically that the gun and carriage have moved only a very short distance when the projectile has just left the muzzle; and that the maximum velocity of recoil is not attained till a short time afterwards. For after the shot has left the muzzle the powder gases escape with some unknown high velocity and mingle with the surrounding air, imparting to it a considerable momentum. Meanwhile the pressure on the base of the bore must last for an appreciable time longer, so that the gun receives an additional recoil after the shot has left the muzzle; and this recoil is greater as the weight of the charge and the powder pressure up to the muzzle is greater."

It will be seen that the all-important question o gas efflux is dismissed in a very few words, and it certainly seems like begging the question to suggest that the gases emerge from the muzzle with some unknown high velocity. It is possible, as has frequently been demonstrated, to give a value to this velocity and so deduce the recoil of any combination of gun or cartridge with very great accuracy. In this particular branch of research it really seems as though small arms calculations have carried the mathematical treatment of recoil very much further than is the case with ordnance theory and experiments. Whatever the cause may be it really seems as though the small arms method of regarding recoil lends itself to the simplest arithmetical treatment, whilst at the same time telling the student more about recoil than he can possibly learn from a careful perusal of the ordnance treatises. Professor Greenhill, who is the authority in these matters, repudiates the practice of giving a mean value to the velocity of efflux, because the component parts of the gas blast have a variety of velocities. If this principle of repudiating averages were applied to scatter guns, the useful test of velocity would never have been made, because a shot charge has as many velocities as there are pellets. In small arms his scruples have been disregarded, and a useful series of efflux values has been obtained which enable the amount of gun recoil to be calculated to within a very small margin of the actual amounts registered. In shot guns for instance, where the estimation of recoil is greatly hindered by the difficulty of arriving at the exact muzzle velocity from tests of time of flight over measured distances, there has still been no

difficulty in fixing the following rates of muzzle efflux for the three classes of powder mentioned :—

Black Powder	1,700 f.s.
Schultze	2,200 f.s.
E.C	1,700 f.s.

Whether the whole of the gas comes out with a substantially uniform velocity or whether it comes out in a stream of varying force is immaterial from the recoil point of view. The weight of the gas is the same as that of the powder charge, its momentum is known ; and the value for velocity, which is obtained by division, gives the characteristic rate of outflow which is true for a given powder within reasonable limits of variation as regards length of barrel and pressure.

Colonel Bethell, whose recent work *Modern Guns aud Gunnery* has been noticed in these columns, also attacks the recoil problem ; and though he makes his points quite clear it will be seen from the following extracts that he ceases to be definite when the question of recoil due to gas efflux comes up for treatment :—

" When a gun is fired, the shell and the gun fly in opposite directions with velocities inversely proportional to their weights ; that is, if we neglect the weight of the powder, which will be considered hereafter. If a shell weighing 10lbs. be fired from a gun weighing 1000lbs., then if the shell starts at 100 feet per second the gun will recoil at 10 feet per second."

* * *

" In order to simplify the question, we have so far left out of account the weight of the powder charge. This must however be reckoned with, as it adds materially to the recoil energy. In old text-books it was customary to consider the powder-charge as igniting from the middle, one half going forwards with the shell, and the other half backwards with the gun. In calculating recoil-velocities half the weight of the charge was added to the weight of the shell, the other half to the weight of the gun. This is however unsound, since the whole charge is propelled out of the gun before the latter has finished recoiling. And besides this, the explosions of the charge takes more effect upon the gun than it does upon the shell. For the forward impulse communicated to the latter by the expanding gases ceases when it has gone a yard or so from the muzzle, whereas the burning gases still continue to issue from the gun, producing a strong unbalanced pressure upon the breech, when the shell is already a hundred yards distant on its way."

It will be apparent from reading Colonel Bethell that the same error has been made, viz., to treat gas efflux as far too abstruse for introducing to the student, yet at the same time he admits that calculations are useless without it. An attempt will now be made to set out the whole question of recoil estimation upon the simple basis which is rendered possible by the acceptance of a definite constant to express gas efflux.

Action and reaction being equal and opposite it is necessary, in the case of a gun's recoil, to find the momentum values of the various materials which are projected from the muzzle, and so demonstrate their equality of momentum with that of the gun's backward movement. The above law is expressed in the following simple fashion :—

$$M\ V = m\ v$$

This means that the mass, which may be regarded as the pounds weight of the gun, multiplied by the velocity of recoil is exactly equal to the mass of the ejected materials multiplied by their respective velocities. The recoil of the gun, whether regarded from the point of view of its velocity, the weight being known, or as the product of weight and velocity, is a quantity susceptible to easy mea urement. The experiment is simple enough as experiments go ; but there are many reasons for having conveniently available a ready means of calculating what the recoil of a gun should be under sundry variations affecting not only the gun but also the nature of the charge it propels. The experimental measurement of recoil is, therefore, more useful for determining constants to be used in future calculations than as a means of arriving at the hundred-and-one results which have to be considered when dealing with the recoil of an infinite variety of gun weights and charges.

It, therefore, becomes necessary to split up the value $m\ v$ in the above calculation so as to provide symbols for the various factors which have to be taken into account. Recoil may in the first place be traced to three different sources, and these may be set out in the following manner :—

M V due to shot = *weight of shot* × *muzzle velocity.*

M V due to powder before shot leaves muzzle.
= *weight of powder* × *half muzzle velocity.*

M V due to powder after departure of shot
= *weight of powder* × *rate of efflux from muzzle.*

The above three elements of recoil merely express a convenient system of dividing the $m\ v$ into three sections. The first and most easily measured source of recoil is the forward motion of the shot. Its value in $m\ v$ units is expressed by its weight multiplied by the muzzle velocity. This accounts for about two-thirds of the gun's recoil, and what remains is clearly due to the powder. The weight of the powder is obviously that of the charge put into the cartridge, but its velocity, although a large factor in the production of recoil, and out of all proportion to its weight, defies all attempts at direct measurement. One may, however, divide the recoil producing properties of the powder charge into two sections, the first giving place to the second at the moment when the shot leaves the muzzle. This enables us to deduce that part of the recoil due to the powder from the measured muzzle velocity of the shot. That is to say at the moment when the shot leaves the muzzle the powder gases are distributed fairly evenly along the whole length of the bore. Their centre of gravity accordingly occupies a midway point. Hence while the shot has traversed the whole length of the bore the powder has spread itself in such a way that its average rate of movement at the moment under consideration is half that of the shot. This is because during the time that the shot has moved from one end of the bore to the other the powder has shifted its centre of gravity from the powder chamber to the centre of the bore. Therefore the momentum of the powder at the moment when the shot leaves the muzzle is its weight multiplied by half the muzzle velocity of the shot. For convenience of manipulation it is easier to divide the weight of the powder by two than the muzzle velocity. This enables the first two elements of recoil to be considered together, and worked out by a single process of arithmetic. That is to say the weight of the shot is added to half the weight of the powder charge, and the total is multiplied by the muzzle velocity.

This leaves undealt with the final elements of recoil which the *Text Book of Gunnery* characterises as the escape of the powder gases with some unknown high velocity. Actual experimental *data* concerning artillery are not readily available. Consequently it may be left to those who have access to the required particulars to apply the present method of treatment to ordnance. In the meantime the elucidation of the gas efflux momentum may be derived from some highly exact experiments with the long and the short service ·303 rifles which were conducted in the year 1903. The results in question have been adopted by the War Office and quoted officially in the House of Lords and the House of Commons. In these experiments the rifles dealt with were freely suspended from strings, and were discharged by mechanism which caused no disturbance of their position. The rifles were perfectly free to recoil and the amount of lift caused by their pendulum motion was neutralised by employing a considerable length of string. The long rifle, with the added fittings for making the tests, weighed exactly nine pounds, and the short rifle eight pounds. The muzzle velocity having been carefully ascertained beforehand three measurements were taken with each gun for determining the velocity of recoil. The results were carefully examined and it was found that in both instances the velocity of efflux could be taken as 3,200 feet-per-second. This value thus becomes a constant for calculating the recoil of small arms firing rifle cordite, and with its aid the third element of recoil can be demonstrated. That is to say the final element of recoil is the weight of the powder gases multiplied by their characteristic velocity of efflux, viz., 3,200 f.s. The first formula may now be re-stated in the following form :—

$$\text{M V} = \left(m + \frac{w}{2}\right) \times v + w \times x$$

Where M = Weight of gun or recoiling part of same.
V = Velocity of Recoil.
m = Weight of Shot.
v = Muzzle Velocity of Shot.
w = Weight of Powder Charge.
x = Constant for rate of gas efflux from muzzle.

This gives the value of recoil in the form of gun momentum, but as velocity of gun recoil is the point of main importance the formula may be transposed as follows :—

$$\text{V} = \frac{\left(m + \frac{w}{2}\right) \times v + w \times x}{\text{M}}$$

Applying the above formula for velocity of recoil to the calculation of the behaviour in this respect of the short and the long ·303 rifles the values for the various symbols may be set out as follows :—

LONG RIFLE.	SHORT RIFLE.
M = 9 lbs	M = 8 lbs.
$m = \frac{215}{7000}$ lb.	$m = \frac{215}{7000}$ lb.
v = 2096 f.s.	v = 2112 f.s.
$w = \frac{30}{7000}$ lb.	$w = \frac{30}{7000}$ lb.
x = 3200 f.s.	x = 3200 f.s.

The recoil of the long rifle then becomes :—

$$\text{V} = \frac{\frac{215 + 15}{7000} \times 2096 + \frac{30}{7000} \times 3200}{9} \text{ f.s.}$$

$$= \frac{68{\cdot}87 + 13{\cdot}76}{9} = 9{\cdot}18 \text{ f.s.}$$

For the short rifle the following figures apply :—

$$\text{V} = \frac{69{\cdot}40 + 13{\cdot}76}{8} = 10{\cdot}395 \text{ f.s.}$$

To appreciate the full meaning of the above results it should be understood that the use of a constant is mathematically justified by the circumstance that the same constant is virtually true for both sets of conditions. The tests with the long rifle showed that the velocity of muzzle efflux was 3,219 f.s. With the short rifle the value worked out at 3,153 f.s. One would naturally have supposed that the shorter rifle would have a higher muzzle pressure, and therefore that a higher rate of efflux would be shown. This was probably the case, but the difference is evidently so small as to have been swamped by experimental errors. However the round figure value of 3,200 f.s. was adopted as a constant for rifle cordite in all classes of small arms, and it can be shown that even when comparing two rifles whose construction suggests a difference in the rate of muzzle efflux a recoil calculation based upon a round number value will give results as near the truth as can possibly be expected. The following table shows the actual measurements of recoil velocity as compared with those obtained by calculation :—

LONG RIFLE.		SHORT RIFLE.
1. 9·36 f.s.	By actual Measurement.	4. 10·21 f.s.
2. 9·07 ,,		5. 10·42 ,,
3. 9·14 ,,		6. 10·47 ,,
By calculation **9·18** ,,		By calculation **10·40** ,,

The same constant has been applied to a number of experiments with express and other rifles introducing sundry variations of powder charge, diameter of bore, and weight of bullet, and the calculated velocity of recoil in all instances gives a reliable index of the amount actually found to occur. Whatever, therefore, may be the theoretical aspect of the gas efflux constant, the fact remains that it has a characteristic value for each powder which should enable the artillerist and the text book writer to get into closer touch with recoil than is possible with existing methods. Whether the divergent lengths of different kinds or ordnance exercise a material effect on the velocity of efflux would be readily determined by deducing from guns having a known recoil the value of the efflux constant. The results might show that the same constant would hold good for all classes of gun within a given group. The different sizes of cordite might or might not require separate treatment, but a comparatively small series of values would be found to fit all the ordinary variations, and the student with these figures before him would be able to obtain a much more illuminating knowledge of recoil than is possible under present conditions where perfectly tangible values are dismissed as unknown.

ROUND THE TRADE.

It is understood that arrangements have been completed for the building of an explosives works by Messrs. Kynoch in the vicinity of Durban, Natal.

Those who have not yet obtained the Statutory Rules and Orders 1907, Patents, No. 950 and Designs No. 951 should lose no time in doing so, for the old patent rules have been superseded, and no better ready reference book exists than the official one.

The Comptroller-General of Patents has issued a circular and memorandum calling attention to the new Act so far as it applies to inventions and designs worked abroad. Copies have been addressed as far as possible to every patentee whose name appears in the register.

We have received from the British Olympic Council of 108 Victoria Steet, S.W. a copy of the programme, rules and conditions of competition of the international clay bird shooting contests which it is understood will take place near London in July next in connection with the Olympic Games. Mr. E. H. Stone, secretary of the Clay Bird Shooting Association, has been mainly responsible for making the necessary arrangements.

It was on New Year's day that the explosion and fire, which caused the death of a young man and injury to various other persons, occurred at the premises of Messrs. F. Dyke & Co., wholesale gun and ammunition dealers, St. George's Avenue, Aldermanbury, City. The inquest on the deceased, John Cocker, aged 21, was opened on the 6th ult. Sir Homewood Crawford, the City solicitor and Mr. T. G. Vickery attended on behalf of the Corporation of the City of London, Capt. M. B. Lloyd represented the Home Office. Various other departments and interests were represented. Sir H. Crawford desired to explain in answer to probable criticisms that the Corporation had no power to withhold the registration of premises so long as certain conditions were complied with. He made that statement because it would be a matter of surprise that such a business was allowed to be carried on in the heart of the City. The police surgeon expressed the opinion that the injuries suffered by the deceased were caused by explosions. Some of the burns were inflicted before and some after death. Mr. E. R. Reeve, manager to Messrs. Dyke described the circumstances of the accident. At the adjourned hearing held on the 14th ult. Mr. J. P. Grain had taken over the representation of Messrs. Dyke, and Mr. Gilbert Thorn appeared to represent the Gunmakers' Association. Various witnesses were heard, including persons in the neighbourhood at the time of the explosion or during the fire. Mr. H. E. Winny, inspector of explosives under the Corporation also gave evidence, and Mr. F. Dyke, proprietor of the business. The third hearing took place on the 23rd inst. Sir H. Crawford made a statement concerning previous accidents within the City boundary, and expressed the opinion that the local authority should have power to veto premises unsuitable for the storage of explosives. Lieut. Sladen in giving evidence on behalf of the fire brigade expressed the opinion that the local authority should have more power than at present to see that explosives were only stored in suitable premises. Capt. Lloyd gave evidence to the effect that one of the bins which contained cartridges was found by the examination of the *debris* to have been one of the seats of the explosion. In it were stored a number of 7 mm. blank pin-fire cartridges, the same foreign make, only bulletted, which caused the explosion at Euston in 1898. As to whether these blank cartridges were "Safety cartridges" he did not care to say until experiments had been conducted. The further hearing will take place in the City Coroner's Court, Golden Lane, on the 10th inst.

The E. I. Du Pont De Nemours Powder Company of Wilmington, Del., U.S.A., has forwarded to this office a monthly calendar for the current year, showing a sporting subject extremely well handled artistically, a brown background giving a refined finish to the whole production.

The American shooting papers mention that the Stevens Company have introduced a repeating rifle for firing the ·25 Stevens rim-fire cartridge. This is somewhat remarkable, because the name of Stevens was always associated with single-shot rifles, even in the days when magazine weapons were used for purposes where single-shot rifles are now preferred.

Nobel's Explosives Co., Ld. have forwarded from their Glasgow office a pamphlet and price list dealing with their mining explosives but more particularly electric firing apparatus. The great feature of the booklet is the series of hints and instructions which owe the ease with which they can be understood to the very perfect wash drawings which illustrate each point as it arises.

General Hadden presided on the occasion of a dinner held to celebrate the completion of the work undertaken by a Woolwich local committee in connection with the distribution of compensation to those whose premises had been injured by the explosion which took place nearly a year ago. A sum of £15,000 was placed in the hands of the local committee, but of this only £9,187 odd has been needed to cover the damage caused. General Hadden in making a presentation of plate to the Mayor and town clerk, expressed great appreciation of the businesslike manner in which the committee had completed their work.

At an inquest of a miner's wife the evidence showed that the deceased was engaged with her husband in making gunpowder cartridges for use on the following day, when the powder was accidently ignited. Mr. J. B. Atkinson, who gave evidence, said that in Northumberland the practice of miners making up blasting cartridges at their homes was more common than in any other part of the country, and although the Explosives Act made it a punishable offence, something more definite should be done to stop it. The masters or the men of each colliery should be obliged to equip a properly licensed room where under proper regulations the cartridges could be made with practically complete safety.

Messrs. John E. Whitehouse & Son, gunmakers, of Rutland, have shown great enterprise in laying themselves out to equip rifle clubs, the chief item in their installation being the Whitehouse patent target apparatus. They might advantageously add to their designs a system of target frames interchangeable by hand, for great as is the convenience of the system of winding to and fro on pulleys there are many situations and circumstances where the simpler plan of having accomodation for more shooters at a time, and replacing by hand the used row of targets for a clean set has its advantages. At the range of a certain railway company the winding apparatus is shown to visitors, but the shooters prefer to send one of the number to collect the old cards and replace them with new ones.

The Schultze Gunpowder Co., Ld., ask us to publish the following letter :—"To the directors of the Schultze Gunpowder Co., Ld., 28 Gresham Street, E.C., Gentlemen,—Referring to the correspondence which has passed between your solicitors and ourselves, we write to express our very great regret that we should have sold to customers on three occasions as Schultze cartridges, cartridges which did not in fact contain powder of your Company's manufacture. Whilst we recognise our responsibility for the sales in question, we ask you to accept our assurance that they were made by mistake, and that we will in future take care that the mistake is not repeated. We authorize you to publish this apology if you should think fit to do so. We are, etc., (Signed) C. G. Edwards & Son, Plymouth, Dec. 18, 1907.

NITROGLYCERINE (AFTER SOBRERO).

BY GEORGE W. MACDONALD, M.Sc.

An examination of Sobrero's published researches, after his discovery of nitroglycerine, shows no record of his having again worked on the subject. He lived, however, to see nitroglycerine raised, by the genius and perseverance of Nobel, to the position of first importance as a constituent of modern explosives. The next work on the subject was by J. E. de Vrij, Professer of Chemistry at the school of Medicine in Rotterdam. The physiological effects of nitroglycerine led him to prepare this body and repeat some of Sobrero's experiments. In 1851 he communicated some of his results to the British Association for the Advancement of Science and the Proceedings of that year contain the following note :—" This yellow liquid, nitroglycerine, seems not to be poisonous, but it explodes at a moderate heat, detonating when the drops of nitroglycerine on paper were struck a smart blow with a hammer." De Vrij published a full account of his work in the Dutch Journal of Pharmacy in 1855 in a paper entitled " Nitroglycerine or Glonoine."

" In 1847 when guncotton occupied the attention of all chemists, Sobrero discovered that glycerine treated by a mixture of sulphuric and nitric acids, gave an analogous compound. He thus obtained an oleaginous substance, heavier than water, almost insoluble in that liquid, but soluble in ether and in alcohol. According to the author, the smallest quantity of this liquid occasioned violent headache, whence he concluded that it was a very violent poison. These properties attracted my attention and I endeavoured in 1851 to make this substance. My experiments on a small scale were perfectly satisfactory and enabled me partly to confirm Sobrero's observations, especially the property possessed by nitroglycerine of producing headache ; but, at the same time, I found it could not be a violent poison, since ten drops of this substance administered to a rabbit did not produce any very evident symptoms of poisoning. The desire to know the composition of nitroglycerine determined me to prepare a large quantity of it. These fresh experiments had the unfortunate result of depriving me of sight for a long time in consequence of an explosion of the mixture. After my recovery, I resumed my investigations and prepared a considerable quantity of nitroglycerine, and ascertained several of its properties, which I communicated in the summer of 1851 to the British Association. I then left the subject, until my attention was again called to this product by some articles in the foreign journals, from which I learned that nitroglycerine is now used as a medicine in America under the name of " Glonoine." Besides the interest attached to this product from a chemical point of view, it has, therefore, acquired a pharmaceutical value. This determined me to make known the mode of its preparation and its principal properties. After various trials I prefer the following mode of preparation:—100 grams of glycerine, as far as possible deprived of water at 150° C, and having a sp. gr. of 1·262 were added by degrees to 200 c.c of strong nitric acid, placed in a refrigerating mixture. At each addition of glycerine the temperature rose and I waited till it descended to 0°C. It is necessary to take care during the solution of glycerine in nitric acid that the temperature should be always below 0° C. The mixture was stirred with a glass rod, and, when the glycerine and acid had formed a homogeneous liquid, 200 c.c. of concentrated sulphuric acid were added in small portions at a time. This part of the operation presents the most danger if continued attention is not paid to the temperature. Experience has taught me that there is no danger if the temperature does not exceed 0°C. I once saw the temperature rise as high as 10° C, but between that and 20°C there was a sudden and violent reaction between the glycerine and the nitric acid, and in consequence of which the liquid was violently projected out of the vessel. This inconvenience is completely avoided by keeping the temperature below 0°C. With this precaution the nitroglycerine, after the addition of sulphuric acid, separated in the form of an oil floating on the surface of the acid and was removed by means of a funnel with a tap. The quantity of this impure product, containing a little acid, amounted to 200 grams. I produced about 20 grams more by mixing with water the acid which had separated from it. These 220 grams were then dissolved in as small a quantity of ether as possible, and the solution was agitated several times with cold water, until it no longer reddened litmus. It was then evaporated on a sand bath and heated until the nitroglycerine no longer lost weight. The quantity of pure product thus obtained amounted to 184 grams. The composition of glycerine is $C_3H_8O_3 = 92$ so that the yield of 184 grams from 100 grams of glycerine leads us to presume that the composition of nitroglycerine would be represented by $C_3H_6O(NO_3)_2 = 182$. I am now engaged in trying to ascertain whether this composition is correct. The properties of nitroglycerine are as follows. It is a pale yellow oleaginous liquid with a density of 1·595 – 1·600 at the ordinary temperature. Heated to 160° C. it decomposes disengaging red vapours. At a higher temperature it explodes. breaking the vessel in which it is contained, or else it inflames without detonating. I do not know the precise temperature at which this detonation takes place. It will be best observed by heating a porcelain plate, removing it from the fire, and dropping a little nitroglycerine on it occasionally. As long as the temperature continues too high it burns with an intense flame ; but as the temperature falls, the nitroglycerine, as it strikes the plate, disengages thick vapours and detonates with great violence breaking the plate. Detonation is always produced when nitroglycerine is struck with a hammer on an anvil. When properly prepared, and free from acid, it forms a very constant compound. I have now some nitroglycerine which has been prepared for more than two years, and which remains quite unaltered. Sulphuretted hydrogen decomposes the ethereal solution and separates from it a large quantity of sulphur. The products of this reaction, which I am now studying, will perhaps throw some light on the composition of nitroglycerine." De Vrij's method of preparation would naturally tend to give him low yields, and this fact misled

him as to the composition of nitroglycerine. He must have been using an impure sample of nitroglycerine when he states, that, in ethereal solution, it reduces sulphuretted hydrogen to sulphur.

The first analysis of nitroglycerine was made by Robert Railton who in 1855 communicated a paper to the Chemical Society, London, entitled "On nitroglycerine and the products of its decomposition by potash."

"Sobrero discovered nitroglycerine but did not determine its composition. The compound from which the following results were obtained was thus prepared. Equal volumes of concentrated nitric and sulphuric acids, were mixed and cooled in ice-cold water. Syrupy glycerine was introduced in a few drops at a time, shaken, and cooled each time. After some time the product floated on top, as an oily liquid. It was then poured into cold distilled water and repeatedly washed in this menstruum, by decantation. It was afterwards freed as much as possible from water by means of blotting paper, and an attempt was made to dry it more completely under the bell-jar of an air-pump, but without success, as it was rapidly decomposed on exhausting the jar. From this circumstance the hydrogen could not be estimated, but the relative amounts of carbon and nitrogen were satisfactorily determined by Liebig's process. About 1gr. of nitroglycerine was mixed with as much copper oxide as half filled a combustion tube, about 36inches long. About eight inches of the remainder of the tube was filled with copper oxide and the remainder of the tube was then wholly filled with reduced copper. The tube was then enveloped in copper foil and the combustion proceeded with, and the mixed gases collected in a graduated tube over mercury. The first portion of the gas was allowed to escape. Four tubes were filled and the following are the results in the order in which they were collected.

	I.	II.	III.	IV.
Volume of Mixed Gases	101	91·5	99	97
Volume absorbed by Caustic Potash	69	61·0	65	64
Volume remaining unabsorbed	32	30·5	34	33

There being slight discrepancies in these results, I obtained tubes more finely divided, when a second experiment gave :—

	I.	II.	III.	IV.	V.
Volume of Mixed Gases	178	194	192	173	194
Volume absorbed by Caustic Potash	117	128	127	115	129
Volume remaining unabsorbed	61	66	65	58	65

Now, as the composition of glycerine is well known, and as the volume of nitrogen is proved to be half that of the carbon dioxide absorbed by potash, we may safely assume the following to be the change which glycerine undergoes.

$$C_3H_8O_3 + 3HNO_3 = C_3H_5(NO_3)_3 + 3H_2O$$

Nitroglycerine, when boiled for some time with an aqueous solution of potash, is decomposed. Potassium nitrate and glycerine are formed. A solution of caustic potash in water was made of nearly the same sp. gr. as nitroglycerine. The mixture was boiled for several hours. At the end, the liquid became completely homogeneous when it was carefully neutralised with pure sulphuric acid. The potassium sulphate was crystallised out and on further evaporation potassium nitrate was deposited. This salt was purified by repeated crystallisation and afterwards analysed as sulphate. For the purpose of obtaining the glycerine, the solution from which the potassium nitrate had been crystallised out, was evaporated to a syrupy condition and treated with absolute alcohol. The solution of glycerine in alcohol thus obtained was evaporated in a water bath, and the residue treated with ether, in which nitroglycerine, had there been any undecomposed, would have been dissolved. The ether was removed without having dissolved anything, and a portion of the residue heated with acid potassium sulphate, when the pungent odour of acrolein was evolved. The decomposition of nitroglycerine by means of caustic potash, may thus be represented by the equation :—

$$C_3H_5(NO_3)_3 + 3KOH = C_3H_8O_3 + 3KNO_3.$$"

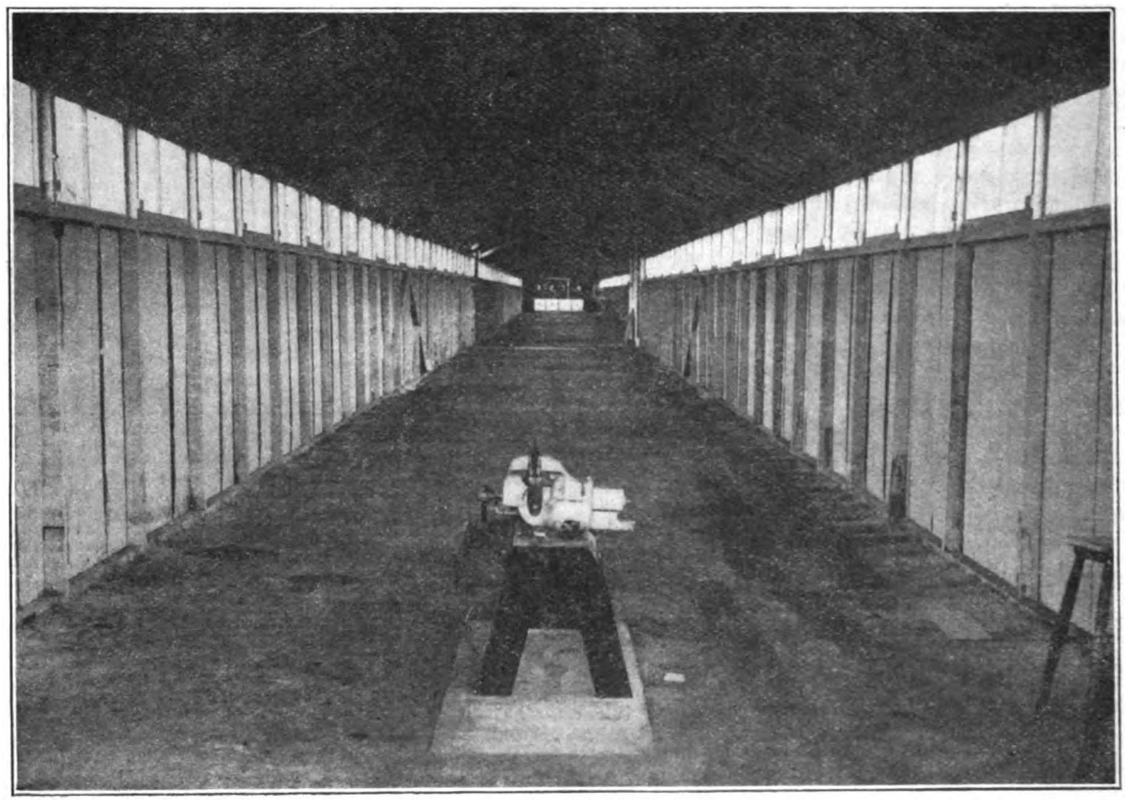
It is rather a remarkable fact that 32 years elapsed, from the date of the publication of Railton's paper, before a complete analysis of nitroglycerine was published. Several workers had determined the percentage of nitrogen in nitroglycerine, with very varying results. Railton's explanation of the mode of decomposition of nitroglycerine by potash was also accepted, in the main, as correct. It was not until 1887 that Hay and Masson published in the *Transactions of the Royal Society of Edinburgh*, a very complete investigation of the composition of nitroglycerine, and showed that Railton's formula for the decomposition of nitroglycerine by potash was not correct.

THE N.R.A. REPORT.—The annual report of the National Rifle Association has just been issued, and the accounts show a surplus on revenue account amounting to £754, and on practice ranges account to £600. After deducting the usual percentage for depreciation, these amounts compare with £314 and £399 respectively during 1906. The amount received from entrance fees was £15,117, and from pool and practice shots £1,376, as against £13,913 and £1,349 respectively in 1906. Additional buildings and plant have cost £1,159, and £250 was subscribed towards the expenses of the Australian match team. In an appendix to the report the scores are given of the various matches of the British team which visited, first the United States, to take part in the Palma match, and then Australia, where the Empire match was shot. On both these occasions the British team made the lowest score; but it was only in America that they lost by a large margin of points. In the later matches which were shot in Tasmania, Victoria and S uth Australia, to say nothing of the matches against local clubs, the team made a very good showing, mostly taking the first position. The rifle club report for 1907 shows that the capital of the Astor Trust is being rapidly exhausted, and that it will very soon be time to look round and ascertain what fresh sources of supply can be opened up.

THE KING'S NORTON TESTING RANGES.

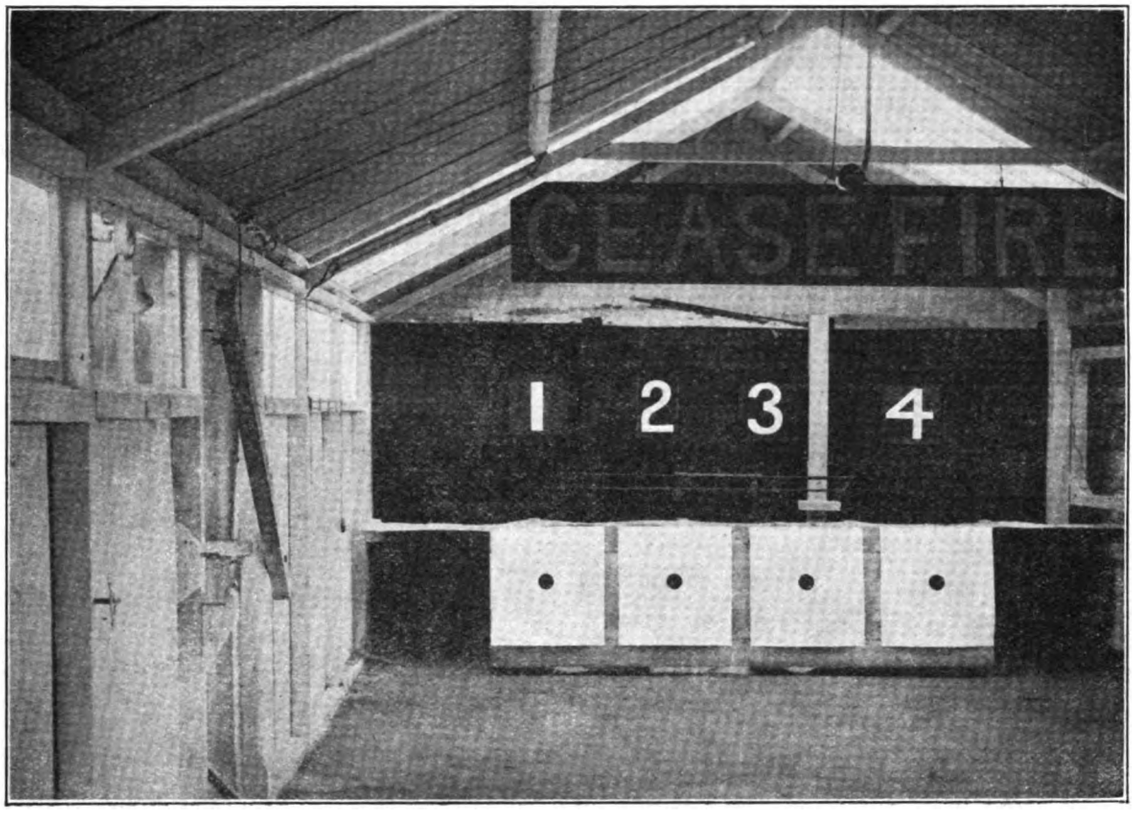
It almost amounts to a romance in cartridge manufacture that the King's Norton Metal Company should have been able to rise at a single bound to the top position as makers of ·22 rifle ammunition. This trade was held for many years in the secure grip of the American firms, whose large turnover enabled them to combine quality and cheapness in a manner that made effective competition seem hopeless. The King's Norton Metal Company, with their well-organised factories in Birmingham and Abbey Wood, seized the opportunity to cater for the needs of the miniature marksman. Their methods of working practically guaranteed success. The Bayliss's, father and son, were metal experts with life-long experience, and Mr. Melville Smith at Abbey Wood knows all the arts of equipping and organising a loading department. This, however, still left unsettled the problem of setting up a standard of test which would ensure mechanical thoroughness of methods producing a good cartridge. Rim-fire ammunition is proverbially difficult to make, and a large amount of research was necessary to ensure a specification which, properly carried out, would produce a satisfactory cartridge. Shooting from a fixed rest was found to be the only means of testing output satisfying the marksman's demand for close-grouping ammunition. Twenty-five yards tests afford a valuable indication of a cartridge's behaviour; 50 yards is better, because faults are apparent at this distance which are not observable at the shorter range; 100 yards is best of all, because none but good cartridges can survive a test at this distance.

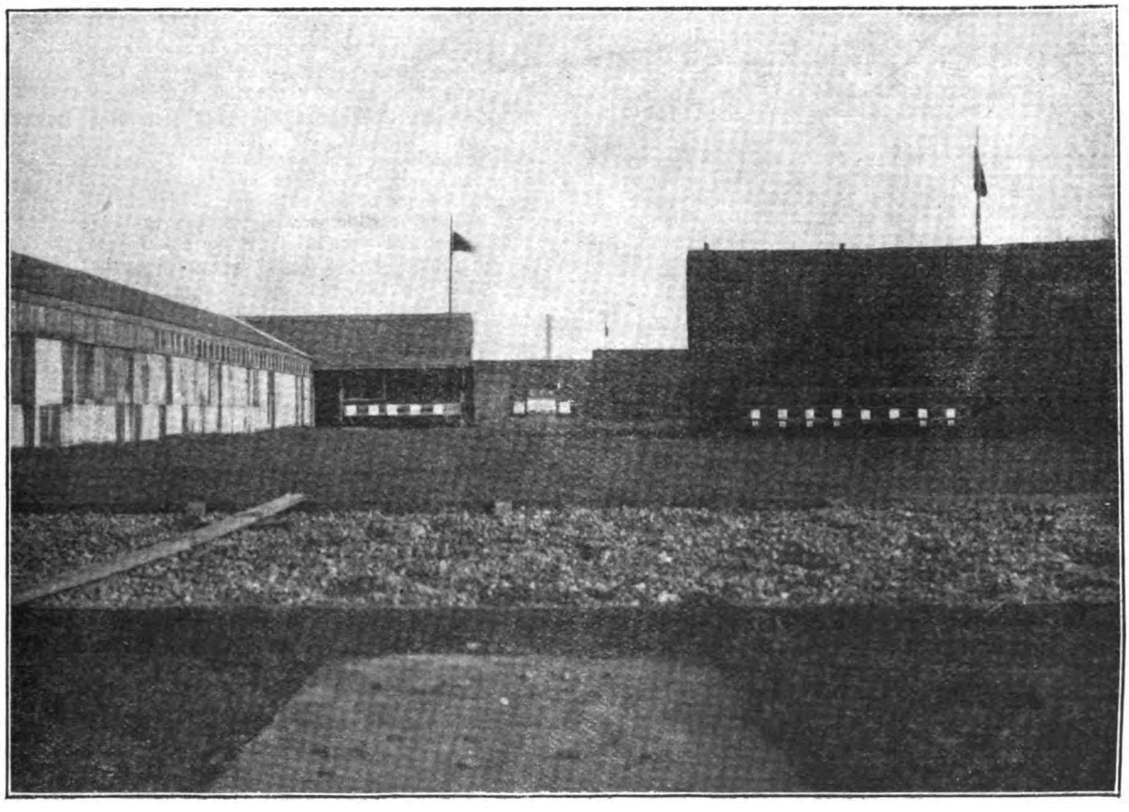
It was accordingly decided that the whole of the King's Norton output should be tested in a covered gallery hour by hour as work proceeds. The accompanying photographs show the extraordinary care which has been devoted to rendering the testing ranges so perfect that work may proceed at all times smoothly and without interruption. The first shows an internal view of the 100 yards gallery which is roofed and glazed from end to end. The vice in the foreground shows the simple procedure adopted for holding the barrel in an immoveable position. Twenty consecutive rounds is the usual test, but the diagram reproduced in the current advertisement pages shows that even with 60 shots the group still retains a compactness which speaks highly for the quality of the output. The



arrangements at the target end of the range are shown in a separate figure. Safety is suitably studied by providing a "cease fire" board which automatically rises and falls with the lowering and uplifting of a bar which falls in front of the safety observation point, thus enabling an onlooker to witness diagrams in the making. The working of the bar also rings a bell which warns the man at the firing point of what is happening.

The third figure shows an outdoor range constructed on the most approved safety principles for the purpose of enabling visitors and the members of the King's Norton Rifle Club to indulge in ordinary rifle shooting practice at all distances up to and including 200 yards. The range is exceptionally well lighted for it has the sun on the targets during the greater part of the day. By its location it is also well protected from wind. In connection with the range is a well fitted gun room with modern appliances for





preserving the conditions of rifles, and also velocity testing apparatus, of which the prominent feature is necessarily a Holden chronograph. There is always a certain amount of doubt whether doctors take their own medicine, but in the parallel case of the King's Norton Company there is no doubt that the Company's remedies for rifle troubles are constantly prescribed and taken. The "K.N." solvent for nickel in military rifles, "P.B." solvent for lead in miniature rifles, and "Leadene," an everyday cleaner for the breaking down of the lead deposits which form during the firing of ·22 rifles, are the Company's specialities. The gun room is specially adapted, by means of suitable racks and sinks, for the early removal of all deposits liable under storage to spoil the smooth finish of the bore.

It might almost be argued that the Company have unduly strained after perfection; but when the details are closely examined it is found that the ability to dispose quickly and finally of all work sent in for proof is of high commercial value, and that manufacturing processes are aided by the constant readiness of the proof department to deal with all problems submitted, while the anticipation of every possible need undoubtedly reduces the chances of what must be termed experimental errors.

So long as the King's Norton Company possesses the only privately owned covered 100 yards range for ·22 rifles and ammunition they may be said to monopolise the means of saying the last word on questions of accuracy, whether they concern the rifle or the cartridge. The shooter's test has always been regarded as giving the final verdict on a rifle or cartridge, but it is slow in operation, and even then must be culled by a process of elimination from the contradictory views and experiences which form the aggregate of personal opinion. The manufacturer who can apply his own hundred yards covered range test, using a carefully selected assortment of rifles and cartridges, can acquire more exact information in the course of a single morning than the shooting fraternity can give him in a month. The success of the King's Norton Company is largely attributable to the first-hand knowledge they are able to obtain of their ammunition before it leaves the factory.

APPLICATIONS FOR PATENTS.

DECEMBER 16, 1907—JANUARY 18, 1908.

27,888.* Ordnance Breech Mechanism. Fried Krupp, A.-G. (German application, April 4, 1907).
27,960. Breech Loading Guns. C. Ryland.
28,019. Small Arms. C. F. H. Bayly.
28,105. Ordnance Loading Apparatus. A. T. Dawson and J. Horne.
28,177.* Automatic Pistols. N. Pieper.
28,486. Projectiles. J. Knight.
28,500.* Machine Gun Carriage Saddle. A. J. Boult.
28,553.* Firearms. S. Rogozea. (Belgian application, December 29, 1906).
28,587. Automatic Rifles. M. G. Farquhar and A. H. Hill.
28,609.* Fuse Setting Machines. Fried Krupp, A.-G. (German application, May 25, 1907).
28,641.* Targets and Shields. C. H. Petry.
28,732. Explosive Shells. M. Charissis.
28,755.* Liquid Recoil Brakes for Guns. Rheinische Metallwaaren und Maschinenfabrik. (German application, January 17, 1907).
51. Ordnance Firing Handles. Sir W. G. Armstrong, Whitworth & Co., Ld., and F. G. D. Johnston.
208. Ordnance Loading Apparatus. A. T. Dawson, and J. Horne.
219.* Machine Gun with Telescope. A. G. Bloxam.
351.* Cartridges. H. J. Haddan.
359. Ammunition. E. Jerrard.
403. Explosives. South African Maganite Explosives Syn., Ld., and H. C. L. Bloxam.
632. Foresight for Rifles. W. Collins.
868.* Barrel Recoil Ordnance. G. Hayn and N. Koch. (German application, May 1, 1907).
869.* Ordnance Sighting Attachments. Fried Krupp, A.-G. (German application, April 19, 1907).
998. Projectiles. S. O. Cowper-Coles.
1,200. Orthoptic Sights for Rifles. J. Webber.
1,227. Target Practice Apparatus. F. Mitchell.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

DECEMBER 27, 1907—JANUARY 16, 1908.

COMPILED BY HENRY TARRANT.

27,281 (1906). **Target Cards.** G. W. Green, Kew. Supplementary to the ordinary concentric circles on a card target the patentee arranges a second series of concentric circles each at predetermined distances from the ordinary ones. The supplementary circles may either be half or the whole of the diameter of the bullet from the others so that the exact value of the hit way be determined. Accepted Nov. 30, 1907.

27,394 (1906). **Breech Mechanism of Ordnance.** C. Holmstrom, London, and J. Brown & Co., Sheffield. The clip or catch used to hold the carrier to the gun during the rectilinear movement of the breech block (before the swinging movement starts) is improved upon by the above patentees. The modified form of catch without springs retains the breech block in its retracted position on the carrier by protruding into the path of a flange on the breech block. Accepted Nov. 30, 1907.

27,538 (1906). **Rifle Aiming Apparatus.** F. Mitchell, London. A rifle is suspended by cords from two moveable parts through a rod which is arranged so that it always points at the target. A miniature target is carried on the end of the rifle. When the trigger is pulled the point of the rod pricks the miniature card and indicates exactly where the rifle was pointed at the moment of pulling. The apparatus gives similar results to that known as the "sub-target" machine. Accepted Dec. 4, 1907.

28,704 (1906). **Ordnance Cartridge Retaining Device.** Lieut. A. T. Dawson, and G. T. Buckham, London. To enhance rapidity of firing particularly of guns loaded at elevation, a cartridge retainer and liberator working under the influence of the extractor is introduced. It moves in a plane transverse with respect to the axis of the gun. Accepted Dec. 14, 1907.

28,733 (1906). **Firing Mechanism of Ordnance.** W. Beardmore and Co., Ld., and A. Bremberg, Glasgow. The type of ordnance firing mechanism is improved in which the firing pin is operated by a single spring both to force it to strike the cap and to retract it to normal position. The safety and inter-locking devices arranged in connection with the firing pin are simplified. Accepted Dec. 12, 1907.

28,909 (1906). **Mountings for Ships' Guns.** E. Schneider, France. A tubular carriage for small or medium artillery for ships is provided with parts which engage with corresponding parts on the walls of a well for guidance where the gun is to be "eclipsed." Either in the firing or the covered position the mounting may be locked by means of these parts. Hoisting apparatus is also described. Accepted Dec. 12, 1907.

29,732 (1906). **Tripod Stand for Automatic Guns.** Lieut. A. T. Dawson, and G. T. Buckham, London. The front legs and trail of a quick-firing gun tripod are connected with gearing for enabling them to be adjusted within wide limits and mechanically, instead of by hand. Accepted Dec. 31, 1907.

29,762 (1906). **Ammunition Hoists for Ordnance.** A. F. Petch and F. W. Harding, London. Ammunition hoists in which the powder charges are delivered to the hoist cage at a level above that at which the projectiles are delivered

are provided by the patentees with an auxiliary cage to lower the powder to the projectile level. Other modifications are described. Accepted Dec. 31, 1907.

295 (1907). **Sighting Apparatus for Ordnance.** Lieut. A. T. Dawson, and G. T. Buckham, London. Electric apparatus for setting the range dial pointer such as is described in patent No. 4,404, 1906 is combined with apparatus set out in specification No. 13,102, 1906 to allow not only of the pointer being set in the proper position for imparting correct elevation but also of an automatic correction to compensate for changes in muzzle velocity or temperature. This improved apparatus is applicable to duplex sights of the cross-connected type. Accepted Dec. 31, 1907.

673 (1907). **Sighting Apparatus for Ordnance.** Lieut. A. T. Dawson, and G. T. Buckham, London. With gun sighting apparatus (4,404, 1906) is combined a "calibrating" device (13,102, 1906) as is set forth in the patent dealt with immediately above, No. 295, 1907. The "calibrating" device (which allows of corrections for variations in muzzle velocity and temperature of charges) is modified so that the pointer receives movement from the hand gear as well as the motor, varying with the adjustment of the calibrating device and the extent to which the range dial is angularly displaced in setting the sights. Accepted Dec. 31, 1907.

1,000 (1907). **Bolt Action Rifle Mechanism.** The Birmingham Small Arms Co., Ld., A. H. M. Driver, and G. Norman, Birmingham. The bolt head of bolt rifles of the "War Office Miniature" type is provided with two extractors adapted to make a two-point engagement with the upper portion of the cartridge head and to co-operate with an ejector stud in the bolt head raceway. Two guides on the side of the bolt head are also provided to work in grooves in the sides of the body to prevent upward displacement of the bolt head. Accepted Dec. 31, 1907.

1,251 (1907). **Illumination of Sighting Telescopes.** Capt. M. da S. Netto, France. To obviate the disadvantage of a very bright light dazzling the eye of the gunner sighting ordnance through a telescope, rays of coloured light of small illuminating power are passed through an opening in the casing and through the transparent portion of the periphery of a glass disc. The remaining portion of the periphery of the disc has a reflecting surface. Accepted Dec. 19, 1907.

4,275 (1907). **Small Arm Bullets.** L. B. Taylor, Birmingham. To throw the centre of gravity of a bullet some distance rear of the middle of its length the nose is left hollow although it is entirely covered. The rear portion is solid and is enclosed in a mantle of hard metal of any desirable length. Accepted Dec. 19, 1907.

5,193 (1907). **Quick Firing Guns.** J. Kirchhof, Berlin. In quick-firing guns the recoil operates on a lever to cock the firing pin. To this lever is fitted a projection by the patentee which through the medium of a stop on the breech casing is turned over to automatically open the breech. Accepted Dec. 5, 1907.

5,883 (1907). **Ammunition Hoist for Ordnance.** A. F. Petch and F. Duncan, London. Apparatus is provided whereby projectile and powder cages charged at different levels may be hoisted by a common hauling apparatus at first at different speeds but subsequently at the same speed. Accepted Dec. 12, 1907.

6,041 (1907). **Telescopic Sights for Ordnance.** O. Forstmann, Germany. To enable the horizon to be swept through a telescopic sight with a movement through angles of less than 90° either to left or to right, three telescopes are arranged with a common axis of exit the three entrance axes of which form consecutive angles each angle being less than 180°. The patentee mentions a previous patent on this subject No. 27,581, 1904. Accepted Dec. 31, 1907.

6,373 (1907). **Air Gun Target.** J. Williams and E. Lawrence, Swansea. The air gun metal target described in this patent is arranged on its face in inclined steps to prevent splashes of the pellet and give a true indication of the value of the shot. Behind the bulls-eye hole is a strip of paper through which a pellet must pass before it strikes a spring-controlled ram adapted to ring a bell. Accepted Dec. 31, 1907.

6,934 (1907). **Cover for Rifle Barrels.** Col. J. W. Ottley, Englefield Green. To protect the hands of the firer and to obviate mirage the patentee invented a cover to be laced over the barrel of a rifle. It was described in patent No. 13,754, 1899. The method of fastening it on the rifle is now altered to facilitate attachment or removal. Accepted Dec. 12, 1907.

7,237 (1907). **Automatic Pistol Mechanism.** B. Clarus, Belgium. A new form of recoil-loading pistol is described in this patent. It may easily be taken to pieces and it is generally constructed with a view to great simplicity and fewness of parts. Accepted Dec. 31, 1907.

7,448 (1907). **Screw Attachment for Rifle Back Sights.** R. A. Rogers, and F. Cantelo, Sandown, I. of W. (*See Selected Patents*).

10,526 (1907). **Manufacture of Nitrate Explosives.** A. Ermel, Belgium. (*See Selected Patents*).

11,905 (1907). **Pedestal Gun Mountings.** A. F. Petch and R. Redpath, London. In pedestal gun mountings in which the pivot can be raised means are provided for causing the pivot to lift the training worm wheel so that they both rise together. The correct engagement of worm wheel and pivot is not altered and the removal of the footstep or bearing is facilitated. Accepted Dec. 19, 1907.

12,147 (1907). **Firing Mechanism of Ordnance.** A. F. Petch, R. Redpath, and H. Hellberg, London. Should the main firing circuit fail through faulty circuit the patentees provide a secondary circuit available for immediate use. Two triggers are arranged, one for each circuit. Accepted Dec. 31, 1907.

12,959 (1907). **Sighting of Ordnance.** A. F. Petch, F. Duncan and O. C. F. King, London. Improved means for setting the sights of ordnance from the fire control station are dealt with in this patent. A motor driven synchronously with and by a motor at the control station sets the sights through another motor and a hunting switch. Accepted Dec. 18, 1907.

16,900 (1907). **Breech Mechanism of Ordnance.** Col. H. C. L. Holden, Woolwich Arsenal. To prevent the firing tube from being ejected from the vent chamber by the rebound of the extractor an improved mechanical device is introduced whereby the tube is definitely masked until the proper time for ejection by the extractor. Accepted Dec. 12, 1907.

16,901 (1907). **Breech Mechanism of Ordnance.** Col. H. C. L. Holden Woolwich Arsenal. The firing tube retainer is, according to this invention made to work in conjunction with a separate plate with inclined ends for lifting the retainer only at the moment of extraction. The separate plate works in combination with the extractor which is prevented from rebounding when the breech mechanism is closed. Accepted Dec. 31, 1907.

20,282 (1907). **Mirror Sighting Device.** Dr. F. A. Schanz, Germany. The fore-sight carries a mirror and a dark circular portion. The back-sight carries a light portion so arranged that when reflected in the mirror the light portion surrounds the dark part on the mirror of the fore-sight. This arrangement is claimed to facilitate the sighting of small arms. Accepted Dec. 5, 1907.

21,117 (1907). **Explosive Oils containing Nitroglycerine.** H. J. Haddan, London. (Agent for *J. F. Lehmann, Germany*). (*See Selected Patents*).

21,778 (1907). **Armour Piercing Projectiles.** Fried Krupp, A.-G., Germany. The penetrative capacity of a projectile is it is claimed increased, and its manufacture simplified by arranging that the steel core nose is exposed and its base closed. Between the envelope which reaches as far as the rear part of the exposed nose and the body of the core is arranged a single coherent piece of soft metal filling. Accepted Dec. 19, 1907.

23,722 (1907). **Supports for Telescopic Sights.** W. E. Lake, London. (Agent for *Winchester Arms Co., U.S.A.*) To prevent rotary movement of a telescopic sight for small arms the underside of the telescope is provided with a dovetail guide rib which works in a slot cut in the top of a spring actuated plunger. The top part of the teles-

cope is pressed upwards against two circular headed studs fitted to the telescope support. Longitudinal movement is permitted. Accepted Dec. 19, 1907.

23,728 (1907). **Telescopic Sight Attachments.** W. E. Lake, London. (Agent for *Winchester Repeating Arms Co., U.S.A.*) A longitudinal slot is formed in the underside of a telescope for use in sighting small-arms and a spring actuated stop on the rear support is arranged to work in this slot so as not to restrict longitudinal movement but to prevent any rotary movement. The front support contains a stop which prevents the telescope being withdrawn too far rearwards after firing. Accepted Dec. 19, 1907.

SELECTED PATENTS.

EXPLOSIVE OILS CONTAINING NITROGLYCERINE.

21,117 (1907). H. J. Haddan, London. (Agent for *J. F. Lehmann, Germany*). This patent deals with a new method of preparing explosive oils containing nitroglycerine having a low freezing point by a process which is regarded as a modification of the Lourenzo process for separating the glycerine and polyglycerine condensed with hydrochloric acid. One part by weight of glycerine is mixed with approximately one-sixth or one-fifth of a part of water or with a quantity of hydrochloric acid in aqueous solution not exceeding one-fifth of the weight of the glycerine. The liquid is more or less saturated with gaseous hydrochloric acid at 100°C and the mixture is then added to a similar quantity of glycerine and the whole is subjected to a temperature of 110°C for 20 to 24 hours. After condensation the remaining traces of free hydrochloric acid may be removed by heating the mixture to a temperature of 150° to 160°C to avoid subsequent interference with the process of nitration. By the process of condensation a product is obtained which contains in addition to unchanged glycerine, monochlorhydrin, dichlorhydrin, diglycerine, chlorhydrin of diglycerine, triglycerine, and chlorhydrin of triglycerine. This mixture is nitrated, which treatment produces in addition to the trinitroglycerine, nitrates of the other compounds mentioned, and of these particularly it is claimed that nitrochlorhydrins give a low freezing point to the mixture. The freezing point is lowered according to the duration of the treatment of the glycerine with hydrochloric acid and to the duration of the condensation. Accepted Dec. 12, 1907.

MANUFACTURE OF NITRATE EXPLOSIVES.

10,526 (1907). A. Ermel, Belgium. A mixture of hydrocarbon, especially of the aromatic series, which is not nitrated or is nitrated only in a small degree, with one or more organic substances, constitutes a known explosive. It is explained by the patentee that the less nitrated the hydrocarbon the greater its insensibility to shock, and *vice versa*. Explosives made from hydrocarbons which are not nitrated are, it is stated, liable to fail to detonate after storage for a few days and therefore they are generally nitrated to some degree mostly by the addition of dinitrotoluene, trinitrotoluene, dinitrobenzine, dinitronapthaline or the nitro-derivatives of phenol. A supporter of combustion such as ammonium nitrate is also incorporated. Certain defects are said to accompany the advantages attended by the addition of these substances and to overcome them nitrate of lead has been added. The sensitiveness of the explosive is thereby increased but its safety is diminished and the introduction of a lead salt into the manufacture of the explosive produces injurious effects upon the operatives.

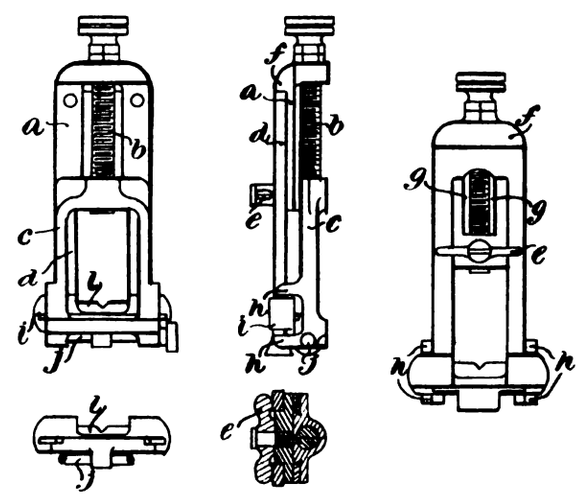
The defects mentioned above are remedied according to this patent by introducing about 3% of a hydrocarbon or hydrocarbon derivative, liquid at the ordinary temperature and not distilling in any case below a temperature at which nitrate explosives are dried. Glycerine is said for this purpose to be particularly suitable whilst mononitro-derivatives may be substituted. As they may interest our readers the patentees claims are appended:

(1) In the manufacture of nitrate explosives, for the purpose of rendering practicable the introduction of lead nitrate into the explosive, adding to the mixture constituting the explosive a small proportion of a hydrocarbon or hydrocarbon derivative, such as glycerine, which is liquid at the ordinary temperature and volatilises at a temperature above that at which the explosive is dried.

(2) The modification where there is used as suitable hydrocarbon derivative, one or more mononitro-derivatives of the aromatic series, liquid or solid at the ordinary temperature, volatilising at a high temperature and, if solid, of melting point lower than the temperature at which lead nitrate is incorporated with the other constituents of the explosive. Accepted Dec. 12, 1907.

SCREW ATTACHMENT FOR RIFLE BACK SIGHTS.

7,448 (1907). R. A. Rogers, and F. Cantelo, Sandown, I. of W. The attachment for the tangent leaf of a rifle backsight described in this patent is similar in appearance to a "vernier," and is designed to allow the slide carrying the sighting notch to be accurately adjusted both vertically and laterally.



As will be seen in the appended illustrations, the attachment consists of two parts, one, *a*, at the top carrying the screw *b* and the other *c* in the bridge of which the screw *b* works. The two parts are held on the leaf *d* by the fly nut *e*. The projections *f* and *g* above and below the bridge part of the leaf *d* hold the top portion *a* against movement whilst the bottom part *c* is elevated or lowered when the screw *b* is turned. The forks *h* on the bottom of the part *c* engage the slide *i* which is therefore moved up or down the leaf with the part *c* when the screw *b* is turned.

To move the slide laterally to compensate wind pressure the screw *j* is turned. The threaded portion of this screw works in a projection on the bottom of the slide *l* as is illustrated, this part having the power of transverse movement on the rest of the slide which works up and down the leaf. Accepted Dec. 12, 1907.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 186.—Vol. XVI. MARCH, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

The Chemical Work of the Explosives Department.—Most of the chemical problems which are submitted to the explosives department of the Home Office follow on such well understood lines as to make it seem questionable whether the work they involve should continue to be referred on a consulting basis to an outside professional man known as the chemical adviser to the Home Office. The principle of retaining an outside expert should surely be confined to instances where help is but rarely required and where the authority of the adviser is as great as his knowledge. In the early days of the Explosives Act the work carried out by the late Dr. Dupré fell within the proper limits of professional consulting work. As years went on the volume of work increased to a steady stream, and experience became more important than high professional attainments. The explosives trade is bound by Act of Parliament to submit samples which have to pass certain tests as a condition precedent to the granting of licences and certificates. High fees are charged for perfectly simple routine work, and investigations are frequently made to ascertain obvious facts. So long as the chemical tests which are rendered necessary by the provisions of the Explosives Act continue to be carried out by a private firm of consulting chemists the trade is bound to feel that many unnecessary expenses are created. The explosives department of the Home Office ought to have its own chemical laboratory, under the supervision of an able and competent chief. The secrets which manufacturers are bound to disclose in submitting their samples would thus remain with the Government, and would not be communicated to private individuals. In a similar manner the records, apparatus, and generally speaking the goodwill of the chemical department would be the property of the Government. Continuity would thus be assured, and if a death vacancy occurred a competent understudy would be on the spot to continue the work. If it was advisable to appoint a successor from outside such a course would be rendered possible by the existence under Government control of the necessary laboratory, staff and appliances as a going concern.

Manufacturing Processes at Waltham Abbey.—Sir Frederick Nathan's lecture before the Society of Chemical Industry duly took place on the 3rd ult. It was not so interesting to sit down and listen to a catalogue of facts and statistics as to walk round the factory at Waltham Abbey under the guidance of the lecturer, combining equal doses of practical observation and theoretical instruction. The lecture is, however, the complement of the personal visits which the favoured ones have paid, and a very good substitute for those who have been unable from one cause or another to make a tour of the works. The most striking feature of the story which the lecturer had to tell is that a works which is freely thrown open to the inspection of government contractors and others interested in the manufacture of Service explosives should be able to retain a leading position when favours of this kind are so seldom reciprocated. Waltham Abbey, speaking broadly, tells everything, and receives very little in return. It remains a model factory even when compared with modern erections which have been set up according to the principles evolved at the parent establishment. As regards efficiency of

processes, one cannot say that Waltham Abbey is better or worse than other works. Each manufacturer can compare his own statistics with those published in reference to the Waltham Abbey outfit. Comparison is challenged, and it is at least certain that the standard set up is a high one, and owes much to the originality of procedure which distinguishes the displacement process of making nitroglycerine from the older methods. The lecture was well attended—in fact everyone seemed to be there—and well received. The printed version will, nevertheless, be greatly in request, because it will contain the figures and quantities which could not be noted at the time, but which constituted the gist of many of Sir Frederick's most interesting statements.

The Proposed New Explosives Factory in South Africa.—Mr. Arthur Chamberlain, chairman of Kynoch's, has with characteristic energy been visiting the various mining centres in South Africa for the purpose of considering the relative merits of the different situations in which an explosives factory might be located. At the present time there are two large factories on the spot which deal with the local demand in rivalry with one another, and with the various home firms who cultivate the South African market. The original factory at Modderfontein was erected by the dynamite monopolists previous to the war. Later on its name was anglicized, and it continued to be associated with the Nobel group of interests. The De Beers factory, now separately incorporated as the Cape Explosives Works, Ld., which is situated at Somerset West, is a more recent erection and there is no doubt that competition from this source has done a great deal to keep explosives cheap in South Africa. It has even been suggested that the recent arrangement amongst the manufacturers at home, by which destructive competition will be prevented and prices raised, will not immediately affect the South African market. The Kynoch interest in South Africa is for the time being restricted to an export business from their works in this country, several large contracts, one in particular, giving their firm a definite stake in the market. The sum of £100,000 has been spoken of as necessary to initiate the new venture, but whether this represents the capital outlay on the spot, or the entire capitalisation of the venture has not been made clear. It is more than likely that the South African interest will be run as a separate company, which will be formed to take over the existing rights of the parent concern. This view of the situation is supported by the circumstance that Kynoch's have issued the whole of the capital authorised by the existing articles of association, so that on this ground alone the idea of a separate company is most probable.

The N.R.A. and Methods of Rifle Practice.—At the annual general meeting of the National Rifle Association the chairman took occasion to criticise very strongly the Army Council circular about rifle shooting, which has been unanimously condemned because it seeks to destroy what exists without setting up something practical to take its place. A great point was scored in declaring that constant efforts had been made to keep the methods of rifle shooting at Bisley in touch with military requirements, as defined from time to time by the School of Musketry at Hythe. It was Hythe which declared ten years ago that the standing and kneeling positions were the only ones of real use in war. The N.R.A. incurred heavy financial loss and gained great unpopularity by enforcing these positions at Bisley. The South African war showed within a very few months that the exact contrary was the case, and that against a well-equipped enemy the use of these positions could only be very exceptional. The obvious parallel is of course that the Army Council has been wrongly advised by the Hythe School of Musketry on the subject of rifle shooting, and that a fallacy has been propounded. It is useless to speak with bitterness in such matters. The terms of military employment prevent an officer from properly grasping the technicalities of his daily work until about the time when he is due to be moved to some other sphere. The civilian method of administration—which takes a boy when he is young and trains him in a certain kind of work, keeps him at it year in and year out, from early manhood to middle age, and thence onwards, decades perhaps beyond the age of compulsory retirement in the Army—produces men who know their work as second nature, and everything connected with it. If theory breaks down practical experience is ever ready to provide the commonsense decision. In army matters the theory is there, but the practical experience never exists in sufficient quantities in any single individual. The proportion of mistakes in detail must, therefore, rank very high. As a recent example for instance of the still crude views which are held concerning rifle shooting one hears that the inspection of miniature rifle ranges in the occupation of clubs has led to some of them being certified for use with the ·22 long rifle cartridge, whilst others, considered to be rather less safe, are restricted to the ·22 short. There is no need to enlarge on the amusing, but nevertheless serious, aspects of the foolish distinction which has been drawn.

The Late Mr. Frank Lyall.—One cannot help feeling that the death of a head chemist of an explosive factory from an accident with a ·22 rifle whilst conducting range shooting experiments is analagous to the case of the warrior who survives a trying campaign to die from some trivial accident on arriving home after the war. Mr. Lyall's loss is a very serious one in a trade where the supply of experienced men with managerial capacity is by no means plentiful. Mr. Lyall had achieved a very high position at the Nobel factory, and sympathy must naturally go out to his chiefs and colleagues, who one and all must feel that his life was sacrificed to the odd chance which balances the many close shaves which are constantly occurring in shooting circles. The golden rule for gun experiments of all kinds is to keep the working staff as small as possible, and to discourage the attendance of spectators. Fixed rest experiments with rifles must always possess an element of danger, but the risks can be diminished by automatic safeguards and by strict discipline being enforced upon all who are present by the responsible officer in charge.

THE CITY EXPLOSION.

A certain amount of relief must follow the reading of the inquest proceedings in connection with the City explosion. The fair and impartial summing up by the City coroner, Dr. F. J. Waldo, indicates how little can ever be definitely known. Some kind of explosion occurred, probably a gunpowder explosion, but how or where it originated can only be a matter for surmise. At the time of the accident the premises contained an extraordinary number of blank pin-fire cartridges of German origin. Subsequent experiments have shown that these could not properly be described as safety cartridges, and, therefore, that they had no business to be stored on the premises as such. Pin-fire cartridges in wholesale quantities certainly suggest a state of risk from which ordinary registered premises in the occupation of retail gunmakers can be considered exempt. Pin-fire cartridges have occupied a suspicious relation in connection with so many explosions that very few tears would be shed if they were completely and finally barred from use for evermore. A few stage villains would need to buy fresh pistols, and here and there a gang of hooligans would find that they could no longer purchase ammunition for their pin-fire revolvers. Beyond this no inconvenience would be caused, and a definite step would have been taken to remove the only prominent danger brought into view by the City explosion.

The jury have expressed an opinion that the storage of explosives and the filling of cartridges should be prohibited within the confines of any densely populated area. It is unfortunate in such a connection that ordinary safety cartridges should need to be classed as explosives. One reads that 500lbs. of nitro explosive in the form of safety cartridges may be stored on registered premises. The public at once assumes that the whole 500lbs. is almost sure to be kept, and that the material is of a highly explosive nature. In point of fact the number of safety cartridges stored on registered premises as a rule falls far short of the quantity allowed. Moreover when an explosive is subdivided, in the form of sporting cartridges, to the extent of about two hundred securely closed receptacles for every pound of powder the resulting merchandise can hardly be regarded as combustible, let alone explosive. But the Act says 500lbs. of powder, and the public is impressed with the vision of an open barrel of gunpowder needing only a spark to set it alight. These matters are well understood by the inspectors of explosives, who can be relied upon to see that no sudden panic will be allowed to inconvenience trade under the pretence of diminishing a risk, which from a statistical point of view is very small. Cartridge filling necessarily occupies a very different position from the mere taking into stock of loaded cartridges and storing them like ordinary merchandise, but in the explosion under consideration cartridge filling only really arises as a side issue. The proceedings have focussed public attention on the circumstance that cartridge filling premises may be located in a situation which fire experts would regard as unsuitable, but the only fact which stands clear of all else is the presence of an extraordinary number of pin-fire cartridges.

THE LATE CAPT. THOMSON.

ONE cannot resist the conclusion that there is more than mere coincidence in the fact that Capt. J. H. Thomson is the third inspector of explosives to suffer an utter collapse of the power of mental concentration. The tragic circumstances of the late Chief Inspector's death are merely a proof that his mind had completely given way under the prolonged strain of arduous duties, coupled with an extraordinary share of anxious responsibility. The breakdown of health which first showed itself some six months or so ago in loss of memory, and inability to concentrate the mind, no doubt arose from the unusually anxious crisis which had been precipitated by the necessity to take legal proceedings in connection with certain irregularities which had taken place. These matters, operating on the highly sensitive temperament of a man whose strength came rather from the mind than from physical robustness, no doubt precipitated the trouble. The lives and health of our inspectors of explosives are so valuable that greater care must be taken in the future than in the past to preserve them from undue strain and from the effects of overwork. The annual report of the department, considered merely as a piece of book production, must alone represent an enormous amount of labour, yet it stands merely as a record of work done. If the inspectors are overworked the conditions should be made easier by an increase either of the official staff or of the subordinate helpers.

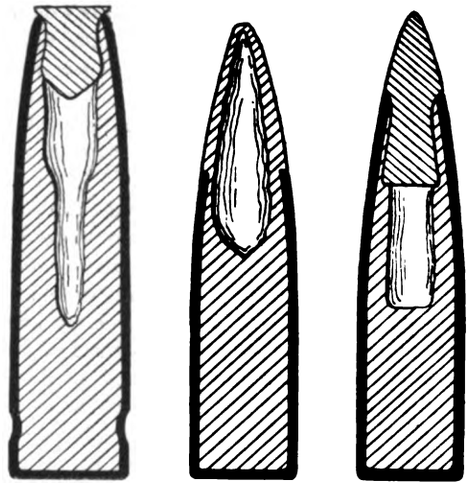
Capt. Thomson's career shows that after his first burst of military service his mind soon turned to scientific pursuits. We read of him being employed by the Royal Society to observe the transit of Venus in Barbados, but it was not until he was appointed secretary of the Explosives Committee, which, to use the historic phrase, "arrived at" cordite, that his name became at all closely associated with explosives. Even then the personality of the secretary was overshadowed by that of the chief actors in the drama which was associated with the early history of our service explosive. Capt. Thomson was known to have acquired a comprehensive grasp of the characteristics of explosive substances; but secretaries of committees are not encouraged to cultivate fame, and it was not, therefore, until Capt. Thomson was appointed inspector of explosives that it was fully realized how able a man had been found to take up on behalf of a younger generation the work which had been so magnificently inaugurated by Sir Vivian Majendie and his colleagues. Capt. Thomson was marked out from the commencement as the future chief inspector of explosives. The ranks rapidly thinned, and his opportunity soon arrived. His record as chief inspector is good, because it has been in the main uneventful. His reputation stands highest amongst those who knew him best, but to everyone it is apparent that he carried out a great task in securing for the explosives department of the Home Office a continuity of the respect and kindly relations with the trade which had grown up under the commanding personality of Sir Vivian Majendie. Capt. Thomson's greatest achievement has been that he followed Sir Vivian, and that no one ever had cause to institute comparisons.

POINTED SPORTING BULLETS.

THE immense impetus which last year's Bisley Meeting gave to the pointed shape of bullet has not produced the consequent change in sporting bullets which might have been anticipated. No one is more alive than the deer-stalker or the big game shooter to the benefits of a bullet having a flat trajectory. The pointed formation undoubtedly aids flatness, and there seems to be no sound reason why what has been found to be appropriate for one purpose should not be equally applicable to what appear to be parallel conditions. The firm of Eley Bros. have devoted a good deal of time to experiments with pointed bullets. They, for instance, made the cartridges which enabled Sir Charles Ross to score his phenomenal success by producing the first rifle giving a 3000 f.s. muzzle velocity. The bullet in the Ross-Eley sporting cartridge was not, however, pointed in shape, although, the military form of this cartridge fires a pointed bullet giving good results under target shooting conditions of test at 1,000 yards. Amongst the forms of bullet which have been made for use in the Ross-Eley cartridge two of special interest are illustrated in the accompanying sketches. The bullet on the left must, however, be dealt with first since it serves to explain why a novelty of some interest and of undoubted originality forms the text of a newspaper article instead of first seeing the light in the pages of a patent specification. The bullet in question is accordingly reproduced as historical evidence that the principle of a steel plug fastened in the nose of a nickel-jacketted bullet, with an air space to its rear, is not in our days a patentable novelty. The bullet illustrated was made many years ago, and is known as Holland's patent pegged bullet.

Dealing now with the series of developments which necessitate the re-introduction of a steel peg forming the nose of a bullet, attention may be called to the central sketch, which depicts a nickel-jacketted sharp-pointed, sporting bullet of light weight construction and, therefore, adapted to give high muzzle velocity. The low density is here obtained wholly by leaving an air space in the nose of the bullet, Snider fashion, the external contour being pointed in accordance with the latest ideas. The large air space forward serves the double purpose of lessening the weight of the bullet, to enhance muzzle velocity, and at the same time giving it the power of great expansion upon striking animal tissues. An elongated lead point of this nature must necessarily be highly fragile, and our artist has undoubtedly expressed in a very realistic fashion the slight loss of shape which the sectionised bullet sent for his use had undergone. With a little care it might be possible to prevent serious deformation of the bullet but even then so fragile a point is undoubtedly a defect, and no shooter would feel confidence in a bullet so liable to lose the power of maintaining a straight course through the air. The arrangement shown in the right hand drawing illustrates the natural sequence from the highly pointed soft nose bullet. A steel peg with its low density and great strength is admirably adapted for forming the tip of a sharp-pointed sporting bullet. It can be securely fastened to the nickel-jacket surrounding the main portion of the bullet, yet give mushroom effects on impact. Besides promoting expansion the air space can be regulated in size for adjusting the weight within any required limits.

An interesting speculation arises in connection with the accompanying illustrations, which have been reproduced as nearly as possible twice the true size of the bullets they depict. The point to be emphasised is that whilst everyone supposes that it would be possible to apply the pointed principle of construction to all sizes of express cartridges in point of fact the sharp nose formation, being purely a question of shape, shape being proportion, what is possible in a ·256 or ·303 is not necessarily applicable to other bores. The accompanying drawings being twice the full size of the military calibre bullets they represent are about the true size and shape of a ·577 bullet exactly reproducing the approved pointed shape. Express bullets have always



HOLLAND'S PATENT PEGGED BULLET. HOLLOW LEAD NOSED POINTED. STEEL PEG POINTED.

been of a length substantially uniform with the bullets of military service cartridges. Their design is, therefore, characterised by an increase of diameter without a relative increase of length. In order to make an express bullet giving the ballistic advantages of the pointed shape, the external contour would be, roughly speaking, that shown by the accompanying diagrams. The conditions of design would involve something approaching a 75 per cent. increase of length with no permissible increase of weight—in fact the prevailing tendency towards diminution of weight would have to be taken into account. A certain length of parallel is necessary in all bullets, so that the highly tapered point must not begin further back than a certain distance from the base.

Against these hindrances to the realization of the pointed express bullet of a calibre much larger than the military, must be set the consideration whether extreme flatness of trajectory over sporting ranges cannot be more readily obtained by raising velocity than by improvements in bullet design.

THE ANALYSIS AND COMPOSITION OF NITROGLYCERINE.

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

IN a previous article (*Arms and Explosives*, Feb. 1908) an account was given of Railton's analysis of nitroglycerine in 1855, using Liebig's method for the estimation of the relative quantities of carbon and nitrogen produced on combustion. The formula of nitroglycerine being taken as $C_3H_5(NO_3)_3$, the ratio of the volumes of carbon dioxide and nitrogen should be as 2 to 1. Railton obtained results varying from 2·156 to 1 down to 1·912 to 1. While these results were, on the whole, in favour of the above formula they were not altogether satisfactory. Railton made no attempt to estimate the carbon and hydrogen absolutely as he found it impossible to dry his nitroglycerine, even in an exhausted receiver, on account of its great tendency to decompose. This proves that his sample was impure, as pure nitroglycerine is perfectly stable *in vacuo*.

In 1871 Beckerhinn (1), who was engaged in a research on the action of ozone on nitroglycerine and guncotton, published in the *Artillery Journal* of Vienna an analysis of nitroglycerine as follows :—

	Found.		Calculated for $C_3H_5(NO_3)_3$.
Carbon ..	15·42	15·62	15·85
Hydrogen	2·27	2·40	2·20
Nitrogen ..	—	17·90	18·50

Subsequent investigators, however, obtained rather widely varying results in their analyses of nitroglycerine.

Hess, (2) in 1874, gives the following figures as the result of his analyses of nitroglycerine by various methods.

Method.	Nitrogen per cent.
Direct estimation of N (Dumas)..	13·9, 14·1
N determined as NH_3 (Siewert)..	14·23
N ,, ,, NO (Schulze)..	13·7, 14·0

He gives in addition the following results for nitroglycerine of various manufacture.

Product.	N %	Method of Manufacture.
Nobel's Zamky (1872)	14·0	Nobel's method
,, (1873)	16·1	
Lithofracteur von Krebs	13·7	Krebs & Luckow
Dualin von Ditmar	13·9	Unknown
Rheinische Dynamit Fabrik Opladen bei Köln	16·6	Mowbray's method No air agitation.

Sauer and Ador (3), in 1877, estimated by three methods, the nitrogen in nitroglycerine obtained from dynamite. They first used Reichardt's modification of Schloesing's method (ferrous chloride and hydrochloric acid), after decomposing the liquid with potash, and obtained results from 12·3 to 14·0 per cent. N. Next they tried ignition with soda-lime but found only 2-3 per cent. of the nitrogen evolved as ammonia. Finally they made four determinations by Dumas' method, from three different samples of dynamite, and obtained 18·35—18·52 per cent of N. which agrees very closely with that calculated from the formula (18·5 per cent).

Hess and Schwab (4), in 1878, made some nitrogen determinations by Dumas' method. In one sample they found 15·72 and 15·65 per cent. of N., and in another (from Nobel's Zamky manufacture of 1872) they found 16·12 per cent. N., though this was the same liquid which four years earlier had yielded Hess only 14·0 per cent. N. It will be noted that there is a wide difference in the results obtained by these investigators for the percentage of nitrogen in nitroglycerine as determined by Dumas' method.

By far the most complete investigation as regards the composition of nitroglycerine was carried out by Hay and Orme Masson (5) in 1887. All investigators, they say, agree in regarding this compound as a nitrate of glycerine, but while some considered it a trinitrate others held that it was a mixture of tri, di and mono-nitrate. Previous analyses were quite insufficient to establish one or the other conclusion, and were mainly confined to the estimation of nitrogen. As the decomposition of nitroglycerine by potash was shown by Hay to occur in a manner considerably different from that suggested by Railton, the main reason in support of the constitution of nitroglycerine as a trinitrate was removed. The nitroglycerine employed by Hay and Masson was made by adding Price's pure glycerine (1 part) drop by drop to a mixture of nitric acid (2 parts) and sulphuric acid (6 parts), the mixture being surrounded by ice and kept at a temperature not exceeding 10°C. Five minutes were allowed to elapse before pouring the mixture into water, and the precipitated nitroglycerine was then washed eight times with large volumes of distilled water and dried for 7 hours in the air bath at 70°C. It finally stood for 12 days over sulphuric acid, in a vacuum desiccator. Not the slightest sign of decomposition ensued and it was found that nitroglycerine after standing one week *in vacuo* had lost less than 0·1 per cent. in weight which showed it was practically dry from the first. It was perfectly colourless and transparent and had a sp. gr. or 1·601 at 14·5°C. The carbon and hydrogen were estimated by ignition in a tube closed and drawn out at one end, and filled with copper oxide and copper in the usual manner. At the termination of the ignition the drawn out point was broken and a stream of oxygen passed. In the first experiment the nitroglycerine was weighed in a glass tube and dropped into the combustion tube; but an explosion occurred at an early stage of ignition, which, though damaging the furnace and injuring one of the experimentors, satisfied them that the explosive force of the quantity of material employed, (0·23 grm.), was not so great as to prevent them continuing the experiments with the adoption of very ordinary precautions. It was ultimately found that the combustion could be performed without

any risk of explosion as follows. Nitroglycerine (0·2—0·4 grm.) was weighed out in a porcelain boat containing finely divided copper oxide and then covered with another layer. The boat was dropped into the combustion tube and the contents well scraped out and mixed with granulated copper oxide. The chief difficulty arose from the introduction of moisture. The precautions were increased in each experiment so that the last hydrogen determination is probably the most reliable. The same means were employed for filling the tube in the Dumas method for the determination of nitrogen. The following results were obtained.:—

	Calculated.	I.	II.	III.	IV.	V.
C_3	15·86	16·05	15·89	15·8	—	—
H_5	2·20	2·99	2·40	2·08	—	—
N_3	18·50	—	—	—	17·93	17·97
O_9	63·44	—	—	—	—	—

Two nitrogen determinations were made with the same nitroglycerine before it was placed *in vacuo*. Results 18·25 and 18·06 per cent. of N. The above figures therefore prove nitroglycerine to be glycerol trinitrate, the slight deficiency of nitrogen being probably due to traces of impurities (oxidised derivatives of glycerine) irremovable by the water with which the nitroglycerine was washed. The nitrogen was also estimated in other samples of nitroglycerine prepared with different proportions of acid, to ascertain whether a difference in the method of preparation caused any corresponding difference in the composition of the liquid. The results show that this is not so. In these cases Dumas' method was not employed but a modification of Schloesing's method which was found to give equally good results, in spite of the contrary experience of Hess and Schwab, and Sauer and Ador.

The weighed quantity of nitroglycerine was dissolved in absolute alcohol and decomposed by boiling for 10 minutes with excess of an alcoholic solution of caustic potash. Water was added and the whole of the alcohol driven off by evaporation; after which the fluid was made up to a given volume of which a measured portion was taken for the experiment The volume of nitric oxide evolved by the reducing action of ferrous chloride and hydrochloric acid was in each case compared with the volume of gas obtained, under precisely the same conditions of temperature and pressure, from a standard solution of pure potassium nitrate and also from sodium nitrite. A correction is however necessary, since a small portion of nitrogen is always evolved as ammonia on boiling nitroglycerine with potash. The amount was determined in a preliminary experiment as follows:—1·1533 grms. of nitroglycerine were dissolved in 5c.c. of absolute alcohol and a solution of 1·5 grms. of caustic potash in absolute alcohol added, the flask being immediately connected with a modified Boussingault apparatus, and then boiled. After half an hour an equal volume of water was added and the boiling continued three quarters of an hour more. The distillate was titrated and found to contain 0·0053 grm. NH_3 which is equal to 0·38 per cent. of N lost as ammonia. This amount was therefore added in each case to the nitrogen found by Schloesing's method. The samples mentioned below were prepared under very varying conditions of acid composition, etc., but the analyses show the products to be identical in composition:—

Sample.	N per cent. found.	N per cent. corrected for loss of NH_3.
A	17·77	18·15
A	17·47	17·85
A	17·76	18·15
B	17·76	18·14
C	17·76	18·14
F	17·41	17·79
J	17·81	18·19
N	17·73	18·11
Nobel's	17·77	18·15

These figures agree closely, not only with each other, but with those obtained by the authors by Dumas' method. The analyses show it to be highly probable that nitroglycerine is invariable in composition, and that the statements of some previous investigators, particularly Hess, are erroneous. If nitroglycerine does, at any time, contain the lower nitrates it is probably owing to very imperfect washing in the process of manufacture. Nitroglycerine is only very slightly soluble in water; glycerine is freely soluble; and, reasoning from the above analogy, it is highly probable that intermediate nitrates possess an intermediate solubility, which will readily permit of their removal by any ordinarily complete washing of the nitroglycerine with water, but may allow only of their partial removal if a limited quantity of water is used. According however, to the published descriptions of various commercial processes for the manufacture of nitroglycerine the washing appears to be sufficiently thorough to remove the lower nitrates, for the amount of washing necessary to remove traces of free acid used in the manufacture of nitroglycerine is certainly quite sufficient to dissolve out the lower nitrates.

(1) *Mitt. uber Gegenstande des Artillerie und Genie Wesen.* (1871), 42-54.
(2) *Zeit. f. anal. Chem.* (1874), 257.
(3) *Berichte* (1877), X., 1982.
(4) *Berichte* (1878), XI., 192.
(5) *Trans. Royal Soc. of Edinburgh* (1887), 87.

THE RIFLE CLUB MOVEMENT.—Lord Roberts, in a letter to the *Times* of the 13th ult., gave an account of the expenditure to date of the funds entrusted to him for disposal in the encouragement of rifle shooting. Most of the money has been employed in forwarding the work of the Society of Miniature Rifle Clubs, and Lord Roberts expressed the hope that this Society will be more strongly supported in the future than it has been in the past, a hope which everyone will echo who has had opportunities for witnessing the excellent administration of this Society, especially in regard to its single-minded devotion to the encouragement of rifle shooting pure and simple, and its freedom from military restrictiveness.

ROUND THE TRADE.

Mr. Oscar Guttmann gives notice that in future his address will be 60, Mark Lane, London, E.C., the old address being No. 12, in the same street.

The latest volume of the Encyclopedie Scientifique is *Ballistique Intérieure* by Charbonnier. A detailed notice of this most valuable addition to the literature of explosives will appear in a forthcoming issue.

The Society of Arts has been granted the right to prefix its title with the word Royal. In years gone by interesting lectures concerning explosives have been delivered at the Society's theatre, but recently the subject has received but little attention.

The clay bird meeting in connection with the Olympic Games will take place on a specially prepared site at the grounds of the Uxenden Shooting School Club during the second week of July. This is the week previous to the Bisley Meeting which commences this year on the 13th of July.

Messrs. Curtis's and Harvey, Ld. have once more earned the enviable distinction of finding that the winner of the Grand Prix at Monte Carlo achieved his victory with the aid of Smokeless Diamond Powder. "Marvellously quick" is a fine phrase to connect with a sporting gunpowder. Such evidence of its appropriateness must indeed be grateful and comforting to its makers.

The London Armoury Company, having secured an agreement by which they have been appointed sole agents for the Winchester Repeating Arms Company of New Haven U.S.A., have been engaged in compiling price lists governing the distribution of Winchester rifles in this country. The retailer will be secured a fair profit, and proper measures will be taken for ensuring the maintenance of the standard retail prices.

The following particulars, taken from an article which appeared in the *Cologne Gazette* of January 10th last, were considered by the Proof House Guardians to be of such interest that they arranged for a copy of it to be forwarded to some of the papers interested in shooting :—"It is estimated that one man in every 100 uses a gun. The shooting licences issued annually are as follows :—Annual licences, 360,000 ; Day Tickets, 180,000 ; Free licences to foresters, etc., 60,000. Estimated amount of game killed : Red Deer 22,500 ; Fallow deer 13,500 ; Roe Deer 190,000 ; Boars 14,000 ; Hares 4,000,000 ; Rabbits 500,000 ; Capercailzie, Black game and Hazel Hens 14,000 ; Partridges 4,000,000 ; Quail 150,000 ; Pheasants 250,000 ; Woodcock 65,000 ; Wildfowl 400,000 ; Bustard 1,300 ; Snipe 80,000 ; Fieldfare 2,000,000. In addition to these, the following fur bearing animals :—Foxes 130,000 ; Badgers 8,000 ; Otters 6,500 ; Wild Cats 1,000 ; Martens 17,000 ; Polecats 4,000 ; Weasels 36,000 ; Estimated amount of shooting rents at 8½d. per hectare (about 2½ acres) £2,000,000. Sporting Dogs kept 200,000, the care of which costs £850,000, and dog tax £50,000. Number of guns in use 800,000, of which it is estimated 10% = 80,000 are renewed annually, at a cost of, at least, £200,000. Ammunition consumed £100,000. Other sporting equipments £300,000. It is estimated that, with travelling and other expenses, the total cost of shooting in Germany amounts annually to the sum of £6,500,000, from which may be deducted £1,500,000 for the value of the game, leaving a net cost of £5,000,000." One cannot help calling attention to the principle of granting day licences, which certainly gives one the impression of meeting the requirements of the occasional shooting guest far better than the English principle of a fortnight's licence at a third of the price for a whole year.

A correspondent recently wrote to this office informing us of a curious experience which occurred at the British Museum. A reader applied to one of the librarians for a copy of the *Text Book of Gunnery*, who after carefully searching the index informed him that no such book could exist, otherwise it would be recorded in the catalogue.

The firm of Gale and Polden have issued some very neatly prepared score books for the use of miniature target shooters. The only criticism which can be advanced is that the diagrams provide more space for recording outers than bulls, whereas the latter are in the large majority. A score book should really only show a life-size circle indicating the bull.

Those who correspond regularly with the firm of Eley Bros. will have noticed that the letters have recently borne the signature of Mr. Cecil Mack as commercial manager. He became well known to many of the firm's customers and friends whilst in charge of their Bisley marquee in 1906 and previous years. As Eley Bros.' representative he made a prolonged journey in the East, from which he returned a few months ago.

At Nobel's Ardeer Factory on the 14th ult., Mr. Frank Lyall, who was second in position to Mr. Lundholm, except of course when Mr. Sayers was at the factory, was accidently shot dead by a ·22 rifle whilst making some range tests. He was engaged in this work with three assistants in the presence of an official from the head office at Glasgow, when on making an adjustment at the target the rifle was inadvertently fired, and the bullet struck him in the back causing death.

It is understood that, after many futile efforts, there is now every prospect of an agreement being concluded amongst the firms interested in sporting ammunition by which, for the period of one year, retail prices will be maintained at a certain fixed level, deliveries to be made solely on the understanding that the prices in question will not be departed from. An incidental effect of the arrangement will be that powder companies will manufacture cheap powders for use in the commoner qualities of cartridge case.

Major Cooper-Key has issued his report concerning the accident at Kynoch's black powder mills at Worsbrough Dale last December, by which two men lost their lives and the manager, Mr. J. G. Sealy, was injured. After reviewing the various circumstances connected with the accident, the report indicates that the most probable cause of the unexpected ignition of the charge, which was undergoing treatment in the press house, was a spark from the chimney shaft. Difficult as it was to realise that a spark could retain its vitality and travel the necessary distance, this is accepted as the most likely explanation.

The Greener conversions of Martini-Henry rifles have enabled the National Rifle Association to supply clubs with miniature ·22 rifles at 26s. 6d. each. Considering that the wholesale price of an interchangeable barrel for a Stevens rifle is from 35s. to 45s. according to length, the retail price above quoted seems woefully cheap, especially when allowance is made for the cost of the rifles at 1s. 6d. each, and the cost of replacing defective parts, to say nothing of the cost of packing and dispatch. The conversion process includes the making and fitting of a new barrel and a new extractor, re-fitting sights and bushing up the fore-end to suit the diminished exterior diameter of the new barrel. So great has been the success of these rifles—we do not of course refer to their commercial success—that the Society of Miniature Rifle Clubs is said to have concluded an arrangement with another Birmingham firm, viz., C. G. Bonehill, for a further series of conversions. The retail price which has been settled is said to be even lower than that fixed by the Greener contract with the National Rifle Association.

THE DECOMPOSITION OF NITROCELLULOSE

REVIEW.

Mémorial des Poudres et Salpêtres, volume 14, parts I. and II., 95 pages. Published by Gauthier Villars, Paris.

This volume of the *Mémorials* contains the following:—A report on miss-fires obtained with safety blasting explosives. A report on investigations respecting the prevention of hail-storms. An article on the experiences of firing against hail at Castelfranco-Veneto during 1902–1906. An article on the decomposition of guncotton at temperatures below its ignition point and also official reports including the rules, for the prevention of accidents, existing in German factories manufacturing smokeless powders. The article on the decomposition of guncotton is of special importance, and calls for detailed notice. This article is a translation from a Russian Artillery Journal and written by M. A. Sapojnikoff, between 1905 and 1907.

It is well known that guncotton ignites and is transformed into gases at below 200°C. At temperatures below its igniting point guncotton decomposes without combustion in a regular manner, the rate of this decomposition decreasing rapidly as the temperature recedes from the temperature of ignition. Dr. Will was the first thoroughly to investigate and determine the rate of decomposition at comparatively high temperatures, and his methods and results are well known in this country. Sapojnikoff criticises the Dr. Will method and points out that it can only be regarded as indicating decomposition under particular and restricted conditions, differing considerably from those which obtain under storage and use. This view is taken because in Dr. Will's apparatus the decomposition takes place in a current of carbonic acid gas which removes the atmospheric oxygen and the products of decomposition and thus gives a fictitious value to the rate of decomposition at the temperature of the test, because the products have a material influence on decompositions. Although the Dr. Will method allows comparatively large quantities of nitrocellulose to be used for the test, this is not considered an advantage since smaller quantities give a volume of gaseous products quite sufficient for estimation and subsequent analysis.

The weight of nitrocellulose used by Sapojnikoff was only one-tenth of that adopted by Dr. Will, viz., approximately 0·25 of a gramme, and in the first researches this was mixed with fine quartz, after Mittasch, but later on the nitrocellulose was decomposed without admixture, in a small vessel connected to the gas collecting and measuring apparatus by fine capillary tubes. The test consisted in submitting the sample to a given temperature and noting at definite intervals of time the volume of gases evolved. At the end of the test the loss of weight due to decomposition was determined and an analysis of the gaseous products was made. The volume of gas evolved per unit of time gradually increased from the commencement of the test. It attained a maximum value and then decreased. This value of the maximum rate or evolution or velocity of decomposition was found to be characteristic of the temperature and of the nitrocellulose submitted to test.

In the tables below the maximum velocity of decomposition is represented as a tangent, for the graphical representation adopted and the figures can therefore be taken as comparative values. Also the total gases evolved are calculated for one gramme weight and therefore about four times the volumes observed.

INSOLUBLE NITROCELLULOSE OF 13·34 % NITROGEN.

Temperature Centigrade.	Duration of test hours.	Volume of gas per 1 grm. c.c.	Percentage composition by volume of gases.				Percentage loss in weight.	Tangent representing max. velocity of decomposition.
			CO_2	CO	NO	N_2		
150	24	325	35·0	20·0	29·9	15·1	70·25	7·85
145	24	358	34·6	18·9	29·6	16·4	69·50	5·38
140	32	309·7	36·5	18·8	28·7	15·9	66·45	2·88
135	130	236	38·5	16·1	22·3	23·2	61·80	0·372
130	140	180·6	30·4	18·7	21·6	29·2	51·13	0·276
125	140	162·2	29·1	18·9	22·9	29·1	49·71	0·221
120	400	161	26·3	19·8	23·4	30·6	47·84	0·084

SOLUBLE NITROCELLULOSE OF 12·0 % NITROGEN.

165	30 mins.		9·9	8·6	46·9	34·6	Explosion	After 30 mins.
160	20	298	28·8	17·2	36·5	17·5	70·6	32·00
155	21	290	28·3	18·5	36·4	16·3	68·3	16·35
150	30	280	27·5	17·7	37·3	17·5	66·0	11·00
145	45	280	35·7	16·8	29·6	18·5	65·0	6·50
140	72	268	36·2	17·6	28·0	18·2	65·0	3·50
135	50	265	33·8	17·9	30·4	17·9	62·0	2·70
130	102	236	34·7	18·7	27·0	19·6	59·3	1·32
125	143	200	32·3	20·0	22·5	24·2	55·6	0·485
120	308	156	30·2	17·4	21·4	31·0	48·6	0·275

PYROCOLLODION NITROGEN 12·75 %.

160	8·5	309	38·3	18·6	27·9	15·2	70·8	39·00
155	11	297	40·4	16·7	22·2	20·8	68·4	20·00
150	31	292	40·5	15·8	21·0	22·7	68·0	10·00
145	31	281	40·0	17·9	22·2	19·9	66·3	6·67
140	77	277	41·3	14·8	22·0	21·9	63·5	3·57
135	81	230	41·5	15·7	21·8	21·0	57·2	1·67
130	167	218	35·2	15·5	21·0	28·3	52·8	0·607
125	217	203	32·2	19·1	22·6	26·1	50·6	0·311
120	382	120	21·3	17·7	25·8	35·2	41·8	0·150

From the details in these tables it is possible to write down equations representing the decomposition and the composition of the residue. With each variety of nitrocellulose these equations would show that as the temperature of the test decreases the proportion of CO_2, CO and NO diminishes. Also the water formed by the insoluble nitrocellulose increases as the temperature falls, but on the other hand the water of the soluble nitrocelluloses remains at a nearly constant proportion.

As regards the velocity of decomposition, the insoluble nitrocellulose shows a sudden rise at 135°C. This is rather remarkable, because this temperature is the one adopted for nearly all destructive tests. Sapojnikoff points out that a rise of 2°C above this temperature doubles the rate of decomposition, therefore 135°C is the most unsuitable temperature for any test.

In conclusion it must be admitted that these researches of Sapojnikoff have materially increased our knowledge on the decomposition of nitrocellulose.

THE CITY EXPLOSION.

THE fourth and final sitting of the inquest in connection with the explosion at Messrs. Dyke's premises near Aldermanbury, City, took place on the 10th ult. Capt. Lloyd had taken the opportunity in the interval since the last sitting, of testing the blank pin-fire cartridges found on the premises by firing one of them in the midst of others, and observing whether the explosion of the one was communicated to any of the others adjoining. As a result of the experiments he had no hesitation in saying that the 7 mm. blank pin-fire cartridges stored by Messrs. Dyke were not "safety cartridges." Though the legal blame rested with the occupiers, he felt that the full moral blame lay with the German firm who manufactured the cartridges and had every opportunity of making experiments. Had he inspected the premises before the fire he did not think there was anything that he would have taken exception to. It was only after making experiments that he found the blank cartridges were not safety cartridges. He did not agree with the City solicitor who had urged that the Corporation should be empowered to enforce stringent regulations. One unusual and unforeseen occurrence could not be held to warrant fresh legislation.

Dr. F. J. Waldo, the City Coroner, then proceeded to sum up in the following terms :—

You will have now heard all the evidence with regard to the explosion at 5, St. George's Avenue, Aldermanbury, on New Year's day, 1908. Your duty is to decide to the best of your ability the cause and circumstances connected with the death of John Coker, a workman in the employ of Mr. Frank Dyke, wholesale gun and ammunition dealer, who occupies the basement and ground floor of the premises in question. The ground floor was used as an office and showroom and at the time of the accident we understand both from Mr. Dyke and from the Manager, Reeve, the ground floor contained guns and accessories, but no ammunition. There was an open fire place with no fire in it, and artificial light was obtained from a three-branch gas chandelier of the old pattern which slides up and down with a water seal. The room over the office was occupied by another tenant. The ground floor office communicated by a doorway and a step ladder to the basement. In the basement were stored a large number of cartridges, percussion caps, knuckle dusters and a certain amount of nitro-compound explosive which will be more readily recognized as smokeless sporting powder. The powder was stored in a small safe in the north-west corner of the room. The cartridges were for the most part stored in various bins or cupboards lining the walls, but a certain number were also packed in boxes and cases on the floor. On the east side were three bins side by side, and the main explosion appears to have taken place in the centre of these three bins. The filling of cartridges was the duty of deceased who, suitably dressed, performed that particular work in the north-east corner of the room behind a screen provided for the purpose. Acting under directions he would take one five pound canister from the safe at a time, and any powder that was left over was at once returned to the safe. The last occasion on which he filled cartridges was according to Reeve, the Manager, some time before Christmas day, whereas, Mr. Dyke thinks it was either one or two days before the explosion. At the south end of the basement was an open fireplace, blocked at the time of the explosion by a case of knuckle-dusters. The basement was partially lighted in the day time by pavement lights and a fanlight window opening inwards from the street. Artificial light was obtained by a twin flexible electric lamp. In the centre of the room were half a dozen or more heavy packing cases. In the centre of the pavement side was a lift worked by hand and communicating with the fan-light window. Close to and above the safe was a gas meter, which led by a composition pipe to the office above. The floor of the basement was of concrete and the walls of plastered brick. In the centre of the north wall was a bricked up doorway which was blown open by the force of the explosion. During the morning the manager, Reeve, and the deceased man Coker had been working in the office above. They were both in the basement at the time of the accident. Reeve was standing near a case in the middle of the room packing knuckle-dusters and was in the act of stooping to pick up a sheet of paper when the explosion occurred and he was thrown violently to the ground. At that time the deceased was standing at the foot of the lift looking over invoices and using the bottom of the lift as a kind of table. For an account of what followed we must depend entirely on the evidence of the witness Reeve. "Immediately I put both hands to my head as the stores were falling about me. I fell backwards on to my back and shoulders. I seemed to feel my senses going. I next recollect trying to find the staircase, and I succeeded but could not get up owing to the falling packages and debris blocking the way. It was all darkness all this time, I made my way then towards the lift in the front. As I came towards it I saw a yellow glimmer not a flame. I clambered on to the lift which was about 3ft. 6in. off the ground. I then reached up and clambered out of the pavement light hole. A civilian helped me and pulled me out. I ran to the corner and in a second or two returned and saw a policeman and firemen, and shouted, 'there's a man down there.' Almost immediately a similar explosion occurred followed by flames. A crowd was there then and I went with the crowd to the corner" It will be seen that there were two explosions and we have it in evidence from various witnesses that there was an interval of some two or three minutes between the explosions, which were followed by a fire and a dropping fusillade of cartridges. One witness, Henry Spain, was actually passing at the time of the explosion and was knocked down. He says "not much smoke followed the first explosion, directly after which he helped Reeve out into the road with the aid of Constable Bradshaw. All three heard the second explosion, and Bradshaw stated that after the second explosion the basement burst into flames. The firemen arrived at 1.15 p.m., five minutes after the first explosion. They flooded the basement with water and extinguished the fire, but were not able to enter the basement for some two hours afterwards. The body of the deceased was then found in the centre of the basement lying face downwards, naked, with face and skull much injured. The evidence of Dr. Kearney, divisional police surgeon, showed that the upper part of the skull had been sheared off, as it were, and the brains had escaped. In his opinion the injuries were consistent with the shattering effects produced by an explosive. With regard to this portion of the evidence I submit to you, gentlemen, that we may at once accept the fact that John Coker met with his death on the 1st. Jan. last as the result of an explosion of cartridges. The metal pin of a cartridge was actually found imbedded in the skull of deceased. Further the explosion was confined to the cartridges, as the powder in the safe was found later to be intact, although the door was ajar to the extent of an inch and a half. Had the nine pounds of smokeless powder contained in the safe also exploded the results might have been still more serious. At this point, it may be well to state that the premises, No. 5, St. George's Avenue, were duly registered by the Corporation of the City of London. The premises were regularly inspected by the official inspector and no complaint was made at any time as to the way in which Mr. Dyke's business was conducted. Under the regulations the occupier of the registered premises is en-

titled to store 50lbs. of loose powder, packed and stored, under certain conditions, together with 500lbs. of powder in the shape of what are described as safety cartridges. Mr. Dyke, therefore, was well within the limit so far as the loose powder was concerned. He also, according to the evidence of the City inspector and his own testimony was within the limit as regards the maximum quantity allowed to be stored in safety cartridges. The only point about which there can be any question is whether all the cartridges stored on his premises at the time of the explosion fell within the technical definition of safety cartridges. According to the Explosives Act "the expression safety cartridges means cartridges for small arms of which the case can be extracted from the small arm after firing, and which are so closed as to prevent any explosion in one cartridge being communicated to other cartridges." By an order of the Secretary of State pin-fire cartridges must be packed in a certain way, namely, "there must not be more than 50 in number in any one consignment so packed in a single package that the bases lie alternately in opposite directions. The bases and pins shall be so fitted into perforations with mill-board or other suitable material as to prevent the firing of any one of the said cartridges by an explosion in any other of the said cartridges." It has been given in evidence, that this order arose out of an explosion at Euston railway station in 1898, when, a consignment of 500 pin-fire cartridges belonging to Mr. Dyke were crushed in transit and an explosion followed. The evidence shows that a large number of these pin-fire cartridges were stored on Mr. Dyke's premises at St. George's Avenue. Mr. Dyke and his manager state that there were about 30,000 pin-fire cartridges out of a total of 130,000 cartridges on the premises. Of the 30,000 some 10,000 were loaded with black powder and were of a cheap German make. Capt. Lloyd, in his evidence tells us that practically all the 10,000 7 mm. blank pin-fire cartridges were missing after the fire, but he found the battered remnants of the tin boxes in which they were packed. We have it in evidence that the majority of the 10,000 blank pin-fire cartridges were stored in the centre bin under the staircase in the east. The main part of the explosion took place in this centre bin while the cartridges in the adjoining bins were hardly touched. We may therefore conclude that the main site of one explosion was the middle bin and that the main basis of the explosion was furnished by the blank pin-fire cartridges. This theory is sustained by the fact that several boxes of ·450 central fire revolver cartridges were afterwards found unexploded notwithstanding that the force to which they had been subjected was so great that—as Capt. Lloyd has told us—"the lid and sides of the boxes have been forced against the cartridges in such a manner as to take a complete mould of the cartridges which each box contains." "Such an imprint," he adds "is the strongest possible evidence of the high gas pressure which is one of the characteristics of the seat of an explosion." Other evidence of that gas pressure, will doubtless occur to your mind in the shape of the blowing out of the pavement lights, of the party wall in the cellar and of the front of the office overhead. Lastly, on Capt. Lloyd's high authority we learn that the effects of the explosion could have been easily generated from a charge of five or ten lbs. of powder, and that the amount contained in the exploded 10,000 pin-fire cartridges totalled to 7·3lbs. of black powder. After a careful review of the evidence I am bound to say that to my mind there is nothing to show whether the first explosion was in the centre bin or elsewhere, or, indeed, assuming that a second explosion actually did take place, what was its nature or its site. Various theories have been suggested to account for the explosion. That of a gas explosion has been fully discussed by several witnesses. In favour of that possibility we have first the fact of the presence of a defective gas chandelier in the shop, and that two out of its three burners were alight at the time of the explosion. On the other hand neither Mr. Dyke nor his Manager Reeve had noticed any smell of gas. Further after Reeve's escape it was found that neither his hair nor his clothes were singed, a condition hardly conceivable if he had come out of a gas explosion. The possibility of loose powder illegally left lying about the basement occurs at once to the mind, but I am bound to point out that there is no evidence of any kind that such was the case. As regards the probability of the electric supply being involved we have no evidence pointing in that direction, although the installation was clearly defective, a point which will be referred to later. So far as smoking is concerned we have it in evidence that no smoking ever went on in the premises. Nor is there anything to show that a lighted match or cigarette may have been thrown down carelessly through the fanlight, and even then it would have to come in contact with loose powder to produce an explosion. In short I submit that we have not a tittle of evidence, direct or indirect, to show what was the cause of the explosion of the pin-fire cartridges, nor, as a matter of fact whether those particular cartridges were concerned in the first or the second explosion. There is clearly room for difference of opinion, and I leave it to you, gentlemen, to say if you agree with Capt. Lloyd's suspicion that the explosion preceded the fire. The structure of the place appears to have been unsuitable in various ways for the purpose of storing explosives. The worst feature is the chandelier, and I think you will have no difficulty in condemning the using of gas as an illuminant under such conditions. The gas meter was placed near the safe containing the powder, clearly an unwise step, and was fitted with a composition pipe, which was actually crossed by the electric lighting wires. These arrangements stand self-condemned. As regards electric lighting the following defects were disclosed. The wires were cased in wood, instead of in a properly constructed and fastened metal tube. Incredible as it may seem the meter and the fuse to the supply were in the next house, cut off by a brick wall, and absolutely out of control of Dyke and his employees. The result was that live wires were in the premises at No. 5, at all times night and day, whether anyone was in the place or not. We have heard from the experts that the flue in the basement should have been closed in order to prevent any sparks or fire from coming down the chimney. With this authoritative view we must all of course agree. We have also heard that the means of escape in case of fire were not adequate. The fact is before us that an explosion has taken place on premises registered by the Corporation for the storing of explosives and the filling of cartridges. There is no reason to suggest that the inspection of the premises was not skilfully and regularly carried out. Indeed, we have from Capt. Lloyd a handsome testimony to the excellence of the City inspectors' supervision. Registration, however, is not accompanied with powers to enforce proper structural and other conditions. I leave it to you, gentlemen, to say whether you think that the amount of control of the Corparation over the premises they register should not be materially increased. The licence to store explosives granted by local authorities carries the power to enforce structural and other conditions in order to insure a reasonable amount of safety. I shall ask you, gentlemen, to say whether in your opinion the system of registering as now practised in the city of London should not be superseded by one of licensing with its accompanying regulations. So far as the fatalities due to City explosions are concerned I feel bound to point out that the death rate from such occurences is extremely low. There is a suddenness and violence about a gunpowder explosion that fascinates the attention of most of us. At the same time when we come to look at the matter in the light of cool judgment we find things are not so bad as we were inclined to imagine. Capt. Lloyd has given us statistics of all fires on 27,927 registered

premises in the United Kingdom whether involving explosion or otherwise. The average number of accidents for 21 years past is not more than 4·1 causing an annual death rate of 1·6 and injuries to 5 persons annually. This does not strike one as a heavy rate for a dangerous environment. Indeed looked at from the point of view of the inherent danger, the explosion at 5, St. George's Avenue shows that there is little risk attached to the storage of safety cartridges even under defective conditions. The fortunate escape of the man Reeve is in itself a proof of his comparative degree of safety. So little risk does there appear to be from proper safety cartridges that I think we are almost warranted in saying that had there been no cheap German pin-fire cartridges in the basement there would have been no explosion. So far as the City is concerned there have been only two accidents in registered premises since the year 1887, and in neither case was there a death. Both resulted from the illegal unloading of cartridges.

In this difficult and complicated case we have been particularly fortunate in having been assisted by so able and eminent an authority as Capt. Lloyd. Without his aid it would have been impossible for inexperienced men to have followed the case intelligently. A word of further commendation may well be added on account of the careful experiment which he has conducted with a view of testing the various kinds of cartridges concerned in this enquiry. Lastly, gentlemen, I must thank you personally for the great care and attention which you have bestowed upon this case. The demand upon your valuable time has been unavoidable and the only practical recognition which it is in my power to offer is to excuse you from further service for the next five years.

With regard to the death of the deceased, John Coker, I think you will have little difficulty in finding that he met with his death on the 1st January, 1908, as the result of an explosion on registered premises, at 5, St. George's Avenue, but that there is no evidence to show how that explosion was caused; in other words that death resulted from accidental causes.

Should there be any doubt in your minds as to whether there was any culpable neglect on the part of any person concerned as regards either the storage of the powder, or other reasonable precautions it is your duty to take the same into consideration in arriving at your verdict.

Coroner's questions with unanimous answers.

1. How, when and where, did the deceased, John Coker, meet with his death? (That John James Coker's death was caused by an explosion which took place on the premises in the occupation of Frank William Dyke at No. 5, St. George's Avenue, E.C. on the 1st day of January, 1908, but that there is no evidence to show how the explosion was caused).

2. Was the main explosion due to the ignition of the German pin-fire cartridges? (There is no evidence to show).

3. How did the explosion originate? (There is no evidence to show).

4. Should not the authorities, whether registering or licensing, in respect to the storing of explosives, have full power to insist upon proper arrangements for artificial lighting? (Yes).

5. Whether the registering authorities under the Explosives Act should not be empowered to refuse to register premises situated in crowded quarters subject to reasonable appeal? (Yes).

6. Should the powers of the City Corporation be materially strengthened as regards the control of the lighting, materials, fittings, structure and other essential details of premises registered by them under the Explosives Act? (Yes).

7. In your opinion should any premises be permitted within the City under the vague conditions of control attached to the existing legislation of premises under the Explosives Act? (No).

8. If the cartridge trade is to be permitted in the City should not the stringent conditions attached to the licensing of *Stores* be exercised to some modified extent by the Corporation? (Unable to answer).

9. Can blank pin-fire cartridges be properly described as safety cartridges from a layman's point of view, and should they be allowed at all, in City premises? (No).

Rider.

The Jury are of opinion that the provisions of the Explosives Act, 1875, with reference to the keeping of explosives and filling cartridges are ineffective and urgently require amendment.

The evidence given at the inquest shows that under the provisions of the Explosives Act, 1875 any person upon payment of a fee of 1/– is entitled to have any building or part of a building registered for keeping gunpowder to the amount of 50lbs., and loaded safety cartridges to the amount of 500lbs. and that the local authority is bound to accept such registration without any discretion as to whether the premises registered are suitable or otherwise.

The Jury are of opinion that the keeping of gunpowder and cartridges in the City or in any largely populated district under the existing regulations is attended with grave risk to life and property and that prompt steps ought to be taken to place the keeping and sale of explosives under more stringent safeguards.

The Jury are of opinion that the Fire Brigade and Salvage Corps under the command of Captain Hamilton and Col. Fox, acted with promptitude and courage on the occasion of the explosion and fire, and that it was owing to their prompt and skilful action that the damage occasioned by the explosion and fire was not considerably extended.

NOBEL-DYNAMITE TRUST CO., LD.—At an extraordinary general meeting of this Company which was held on the 21st ult. for the purpose of sanctioning an increase of capital to provide funds to cover immediate and future requirements arising from the continuous increase of the business, Sir Ralph Anstruther, who presided, contributed some interesting remarks concerning the progress of the industry. This constant and steady growth made it necessary to look some way ahead, but it was only intended at present, with the concurrence of the preference shareholders, to issue a further £500,000 of preference shares, which sum would bring into use £285,400 of the newly-authorized capital. The remarkable development of the explosives trade, and of the trade done by their subsidiary companies, was best illustrated by the fact that the directors could not anticipate with any degree of certainty at the time of the last ordinary general meeting in May, 1907, that an issue of new capital would so soon become necessary. About August, 1906, the sales of their chief subsidiary companies had increased suddenly, straining the capacity of the factories. This condition was maintained in the beginning of 1907, but, when he addressed the shareholders last May, the demand was still regarded as exceptional. Since then, however, the sales had further increased, and, notwithstanding the marked depreciation in the price of metals which had occurred in the last few months, the board did not yet see any sign in the aggregate of diminished mining activity. Not only had the trade of their subsidiary companies expanded rapidly, but that of two of the large companies in which this company was interested had grown so much as to necessitate additional capital, the greater portion of which had had to be subscribed for by the subsidiary and allied companies. Since the meeting in May last, prices had considerably improved compared with the abnormally low rates at which their commodities were selling at that time. The reduction of costs consequent on quantity had co-operated with the increased trade, with the result that there was

every reason to expect that the profits from blasting explosives would be advantageously affected in most, if not all, the undertakings in which they were interested. He qualified this remark because of the position of the British South African Explosives Company, which had for years held its own and paid an average dividend of 5 per cent., notwithstanding competition, including that of a users' factory erected in Cape Colony. Within the last few weeks arrangements had been made for the erection of a third factory, on a site in Natal, and long contracts, at prices which might render the explosives trade on the Witwatersrand unremunerative for years to come, were being offered.

APPLICATIONS FOR PATENTS.

JANUARY 20—FEBRUARY 15, 1908.

1,299. Coincidence Telemeters. O. Eppenstein.
1,348. Toy Projectiles. G. Schrödel.
1,367. Range Finders. A. H. Pollen and H. Isherwood.
1,368. Range Finders. A. H. Pollen and H. Isherwood.
1,369. Ordnance Sighting Gear. A. F. Petch and R. Redpath.
1,384. Cartridges for Mining, E. Purcell and S. Purcell.
1,408.* Fuse Setting Appliance for Projectiles. Fried Krupp.
1,651. Slaughtering Gun. C. Playfair.
1,668.* Spring Guns. P. Lentz.
1,677.* Explosives. F. Sparre.
1,722. Appliance for use with Hammerless Locks to show that the Barrel is Loaded. T. Rigby.
1,749. Shells. W. Hein and C. Otto.
1,813.* Woven Cartridge Carriers. F. R. Batchelder.
1,819.* Charging of Primers. F. Hyronimus.
1,820.* Fuse with Double Action. J. Harlé.
1,890. Toy Gun. P. Sexton and H. Cross.
1,912. Armour-piercing Projectiles. R. G. May.
1,957.* Military Ball Cartridges. F. W. Hebler.
2,097. Anvils for Cartridges. E. Jones and Kynoch Ld.
2,099.* Paper Targets and Holders. A. E. Downing.
2,198. Rifle Breech Mechanism. T. R. R. Ashton.
2,232.* Explosives. F. L. Nathan and R. Robertson.
2,420.* Drop Targets. J. Krcek.
2,447. Slaughtering Guns. C. Playfair.
2,480.* Ordnance Elevating Gear. Fried Krupp.
2,489.* Small Arm Attachments. H. B. Hollifield.
2,509.* Blasting Explosives. C. Claessen.
2,510.* Gun Sighting Apparatus. E. Schneider.
2,544. Ordnance Sighting. L. K. Scott.
2,622. Sighting Devices for Firearms. T. Gilbert-Russell.
2,629. Firing Explosives in Guns, etc. H. Whittington.
2,704. Explosives. W. H. Buckpitt, Junr., and E. H. Taylor.
2,708. Recording Targets. S. A. M. Rose.
2,773. Bullet Catchers for Rifle Ranges. W. W. Greener and F. Crocker.
2,817. Capped Armour-piercing Projectiles. R. A. Hadfield and A. G. M. Jack.
2,882.* Air Guns. H. W. Lake.
2,893. Electric Detonator Fuses. The Thames Ammunition Works, Ld., and H. G. Ticehurst.
2,917.* Recoil-Loading Small Arms. P. Mauser.
2,929.* Shrapnel Shells. R. Wille.
2,932. Projectiles for Signalling Purposes. H. H. P. Dundas, and G. Kohmann.
3,029. Motive Power for Balloons and War Projectiles. F. J. Alderson.
3,078. Ordnance. A. T. Dawson and G. T. Buckham.
3,092. Automatic Guns. A. T. Dawson and G. T. Buckham.
3,102. Instrument to mark Point aimed at. A. M. Faulkner.
3,134.* Ordnance Firing Mechanism. H. T. Wheeler.
3,144.* Ordnance Firing Mechanism. H. T. Wheeler and J. B. K. Lee.
3,195. Moving Targets. D. H. Marrable.
3,227.* Fuse Setting Machines. Fried Krupp.
3,306. Air Rifles. Birmingham Small Arms Co., Ld., A. H. M. Driver and G. Norman.
3,326. Sighting Apparatus. A. G. Downie.
3,361. Rifle Sights. J. T. Peddie.
3,365. Apparatus for Practising Marksmanship. A. Joseph.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

JANUARY 23—FEBRUARY 20, 1908.

COMPILED BY HENRY TARRANT.

936 (1907). **Sling Swivel for Rifles.** The Birmingham Small Arms Co., Ld., and G. Norman, Birmingham. A swivel to take the place of the barrel fixing pin of the "War Office" Miniature Rifle is provided for the rear end of the sling used in holding the rifle steady when target shooting. The swivel may turn to accord with the oblique direction in which the sling is pulled and may be adapted for other rifles besides the one mentioned. Accepted Jan. 9, 1908.

1,088 (1907). **Cartridge Feeding Devices for Machine Guns.** Lieut. F. Ruszitszka, Austria. The cartridge holding devices connected together form a belt for feeding ammunition to a machine gun, and are so arranged that when the mechanism of the gun takes out a cartridge its holder is separated from the rest of the continuous belt. The cartridge may form the connecting medium between the holders or when the links are joined together separately the breech parts are made to disconnect them. Accepted Jan. 9, 1908.

1,545 (1907). **Sights for Night Shooting.** C. A. C. Batten, London. An electric light is mounted on the barrel of a rifle so that it illuminates the foresight but cannot be seen by the shooter. A switch on the grip of the stock not only regulates this light but also another which is placed near the bait employed to attract big game. Accepted Jan. 21, 1908.

1,784 (1907). **Manufacture of Plastic Nitroglycerine Explosives.** Rheinische Dynamitfabrik, Germany. An auxiliary gelatine is added to nitroglycerine and particularly gelatine dynamite. It consists of water, ammoniacal saltpetre and starch or amylaceous substances and its addition is claimed to render the explosives to which it is added less dangerous to handle and safer against fire-damp. The patentees are aware that it has been proposed to add water, ammonium nitrate and starch, but the object of the starch and water has been to prevent absorption of moisture. Accepted Jan. 23, 1908.

2,045 (1907). **Projectile Driving Band.** J. B. Henderson, Lee. The driving band of a projectile is screw or frictionally mounted so that when the projectile is fired the band will impart an accelerating rotary motion to it. Increasing twist of rifling is not needed. A spring is provided between ring and shell and lubricant is squeezed out into the bore as the ring is screwed up on to the shell body. Accepted January 25, 1908.

2,059 (1907). **Cartridge Feed for Machine Guns.** M. von Otto, Russia. A box for delivery of cartridges to a machine gun is provided with one or more compartments each of which contains two vertical rows of cartridges lying in a horizontal position. Spring apparatus is provided to feed the cartridges into the gun in a proper manner. The boxes are hermetically sealed until they are required. Accepted Jan. 23, 1908.

2,339 (1907). **Gun Support for Prone Aiming Drill.** Capt. J. Vuchetich, and P. Rauch, Hungary. A gun support for aiming drill in the prone position consists of a tube in which a rod is adapted to slide. At the top of the rod is a universal joint adapted to allow of any movement of the gun. The apparatus is so constructed that it may be adjusted to any height to correspond with height or distance of the target. Reference is made to Patent No. 10,185, 1901. Accepted Jan. 16, 1908.

3,220 (1907). **Magazine for Automatic Pistols.** G. F. Bouckley, Birmingham. To facilitate loading of automatic pistols, a supplementary magazine something similar to those already in use is withdrawn from the magazine proper in the butt of the pistol, the side of the butt is opened on a hinge, the cartridges are thrown in, the door is closed, and the magazine pushed home. A stop prevents the complete withdrawal of the magazine. Accepted January 30, 1908.

3,199 (1907). **Potassium Chlorate Explosive.** M. A. G. Himalaya, London. In patent No. 4,439, 1907, this inventor described an explosive mixture. A similar one is now dealt with and consists of about 76 parts of chlorate of potash, 10 part of anthracite, and 14 parts of an

oil with or without starch which are mixed together without artificial heat and without water. Binoxide of maganese may be added to strengthen the explosive. Accepted Jan. 9, 1908.

4,437 (1907). **Securing Percussion Caps in Cartridges.** H. H. Lake. London. (Agent for *Centralstelle fur Wissenschaftlich-Technische Untersuchungen G. m. b. H., Germany*). (*See Selected Patents*).

4,823A (1907). **Buffer Stops for Automatic Arms.** P. Mauser. Germany. To save wear and tear in high velocity automatic rifles, buffer springs are provided at back and front of the striking part or guiding projection of the barrel so that the impact of the barrel moving under recoil is elastically weakened. Accepted January 30, 1908.

4,823E (1907). **Auxiliary Magazine for Automatic Rifles** P. Mauser, Germany. A new form of auxiliary magazine is designed to be attached at will to the bottom of ordinary magazine of automatic rifle so as to increase the cartridge holding capacity. The auxiliary magazine has fastenings to take into the hooks which hold the ordinary magazine base plate. Accepted January 30, 1908.

6,066 (1907). **Ordnance Sight.** Fried Krupp, A.G., Germany. The marking of the sight carrier which is adjustable about the axis of the horizontal trunnions independently of the gun barrel is arranged so that the pointer can be caused to register for the purpose of adjusting the elevation of the gun barrel. Other marks are also arranged to facilitate sighting. Accepted Jan. 16, 1908.

7,171 (1907). **Toy Gas Gun.** W. S. Franklin, U.S.A. An acetylene gas generator is attached to a gun in such a way that fine streams may be sprayed into the gun. Sparking terminals are provided for igniting the gas and so expelling the projectile. Accepted Jan. 16, 1908.

9,780 (1907). **Rifle Aiming Apparatus.** H. A. Stebbins and A. A. Adams, U.S.A. Aim recording apparatus subject to recoil such as is dealt with in patents Nos. 745, 1903, 14,636, 1904 is improved. Increased efficiency of the recording apparatus and increased sensitiveness in the movement of the parts connected to follow the aiming device are claimed. Accepted January 30, 1908.

9,876 (1907). **Enveloped Bullets for Small Arms.** King's Norton Metal Co., Ld., and T. A. Bayliss, London, and H. M. Smith, Abbey Wood. (*See Selected Patents*).

11,042 (1907). **Time Fuse Setting Device.** Sir W. G. Armstrong, Whitworth & Co., Ld., and A. G. Hadcock, Newcastle-on-Tyne. For the sake of greater rapidity in setting time fuses provided with serrations or grooves, a device is provided which may be dropped on to the fuse in any position and which will give correct setting so long as the setting ring of the fuse is at zero. The device is combined with a corrector. Accepted Jan. 1908

11,046 (1907). **Ordnance Breech Mechanism.** Sir W. G, Armstrong, Whitworth & Co., Ld., and C. H. Murray Newcastle-on-Tyne. In patent No. 19,240, 1906 a device for preventing rebound of a breech block with interrupted screw threads was dealt with. The mechanism of this device is now altered to obtain greater simplicity and compactness. Accepted Jan. 23, 1908.

13,623 (1907). **Automatic Pistol Mechanism.** C. P. Clement. Belgium. Pistol mechanism operated by recoil is described in this patent. It differs in detail of construction from other known types and has a fixed barrel and recoiling breech bolt. It is said to consist principally of three portions, the body which carries the barrel, the bolt, and the trigger mechanism. A casing round the barrel encloses the reaction spring. Accepted Jan. 9, 1908.

13,924 (1907). **Shoulder Support for Rifles.** R. B. Townshend, Oxford. A shoulder pad is fitted with a cup designed to support the butt of a rifle. The rifle sling is placed round the shooter's neck so that the right hand has only to align the weapon and pull the trigger, the left hand being free. Accepted January 30, 1908.

14,221 (1907). **Electric Fuses for Blasting.** W. A. Malson, Chesterfield. To reduce cost, iron instead of copper wire has been introduced into blasting fuses. To prevent the contact ends of iron wire becoming rusty the patentee proposes to tip them with solder which is a good conductor. Reference is directed in the specification to patents Nos. 26, 1904; 23,031, 1904; and 15,222, 1905. Accepted Jan. 23, 1908.

15,811 (1907). **Telescopic Sights for Small Arms.** Optische Anstalt, C. P. Goerz, A.-G., Germany. The image reversing device of a telescopic sight is arranged in a tube and is separated by a gap from the tube containing the ocular lens, the gap being provided to allow for loading of the rifle, as for instance, from a clip. A dazzle obviator and dust protector are also described. Accepted Jan. 9, 1908.

16,852 (1908). **Fuse Setting Device.** Fried Krupp, A.G. Germany. The bolt which is provided on fuse setting devices for holding the device from being lifted off the fuse is so arranged that it is able to follow the rotation of the setter when the fuse is being set. Accepted Jan. 9, 1908.

17,149 (1907). **Safety for Drop Down Small Arms.** J. Tambour, Paris. Safety devices such as are described in patents Nos. 10,072, 1904 and 20,239, 1905 for small arm locks are improved. The gun can only be fired when the locking device is removed by pressure on a part standing up on the grip. The locking piece may be removed to allow the hammers to be dropped to normal position by overcocking the hammers by finger pressure. Accepted Jan. 16, 1908.

17,892 (1907). **Target Apparatus.** Major A. Müller, Germany. The target apparatus described in patent No. 17,794, 1907 is improved. When struck by a bullet the target falls over and the apparatus governing its movement is modified to make it more certain in action, especially when applied to kneeling and other figure targets. Accepted January 30, 1908.

19,619 (1907). **Ammunition Making Apparatus.** F. Werner, Germany. An oscillator slide is arranged in apparatus for feeding cartridge cases from one to another part of the machine so that the inlet opening is closed when the outlet opening is opened and *vice versa*. The cases are carried, it is claimed, in a sure and continuous manner and they are fed in such quantities as can conveniently be dealt with. Accepted Jan. 9, 1908.

19,668 (1907). **Small Arm Stocks.** R. Frommer, Hungary In addition to a comfortable shoulder piece on the butt of the stock and a pistol grip of real pistol shape, a natural grip for the left hand is arranged in front of the magazine. Accepted Jan. 23, 1908.

20,388 (1907). **Cartridge Making Machinery.** F. Werner, Germany. Cartridges are delivered from one part of a machine to another in proper position for treatment by means of channels and guides having no moving parts or spring controlled slides. Accepted January 30, 1908.

23,336 (1907). **Cartridge Belts.** W. C. Fisher, U.S.A. In the pocket of an ordinary woven cartridge belt a separate woven part is inserted to divide the pocket into two compartments and at the same time to strengthen the bottom to prevent the bullet noses wearing holes. Accepted Jan. 4, 1908.

23,765 (1907). **Ordnance Barrel Carriage.** Fried Krupp, A.G. Germany. Improvements are described in the class of barrel carriage previously dealt with in patent No. 494. 1903. To provide for greater safety against overturning when travelling over uneven roads, the slide of the carriage to which the ordnance recoiling barrel is transferred may be lowered after the barrel is safely shipped. The centre of gravity is consequently carried nearer to the ground. Accepted January 30, 1908.

23,844 (1907). **Cartridge Extracting Device.** R. Reid, Darlington, A scissor-like device with ends adapted to fit under the rim of a sticking cartridge case is attached to a ring in such a way that when the finger is inserted in the ring to pull at the scissors the rim-gripping jaws are forced together. Accepted Jan. 16, 1908.

25,828 (1907). **Projectile Percussion Fuses.** R. Völler, Germany. A "capsule" at the rear of the part carrying the detonator firing pin of the fuse is released by the rotary movement of the shell during flight. The firing pin is forced into the detonator by the "capsule" when the shell strikes. The method of securing the "capsule" by screwing it into the body of the fuse makes for great safety in trans port. Accepted Jan. 2, 1908.

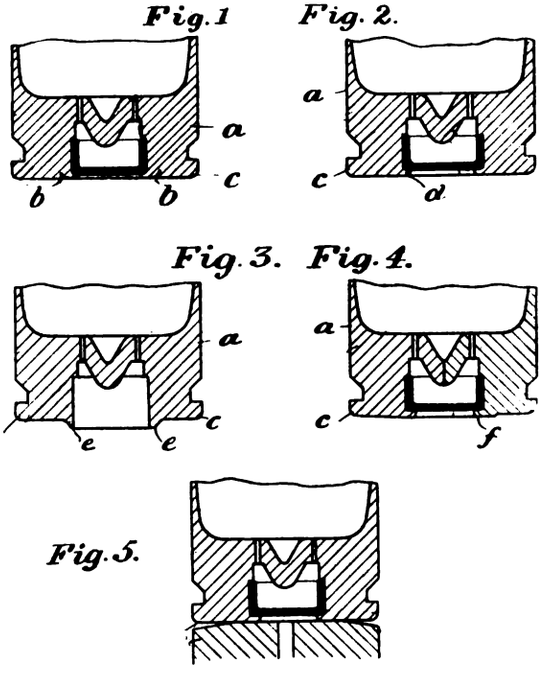
27,078 (1907). **Ammunition Vehicles.** Fried Krupp, A.G., Germany. This vehicle is intended for divided ammunition. The conical bearings or housings for the noses of the projectile are so arranged and shaped that their outsides form bearings for the metal cartridges. Accepted Jan. 9, 1908.

SELECTED PATENTS.

SECURING PERCUSSION CAPS IN CARTRIDGES.

4,437 (1907). H. H. Lake, London. (Agent for *Centralstelle für Wissenschaftlich-Technische Untersuchungen G. m. b. H. Germany*). An improved method is described in this patent of securing percussion caps in the cap chamber of that type of cartridge case in which the case bottom and anvil are formed of one piece of metal.

The usual method of holding the cap in its chamber is by friction alone, but the patentee states that by this arrangement the cap is not always held tightly, first because almost as a general rule the tight metal or alloy of which the cap chamber is made will expand by reason of the small degree of hardness, and second because the cap is usually sunk somewhat deeply in the chamber so that when the explosion occurs the cap is driven back, is deformed by the striker point and the joint is destroyed. The absence of a tight fit between cap and cartridge head allows



gases of combustion to blow back into the action of the arm, the objectionable consequence being that erosion and fouling are set up.

In order that a proper fit may be maintained, the patentee arranges that the cap shall be properly held by a projection against which its edge bears whilst the bottom of the cap is supported by a ledge on the base of the case which is turned up after the cap is inserted.

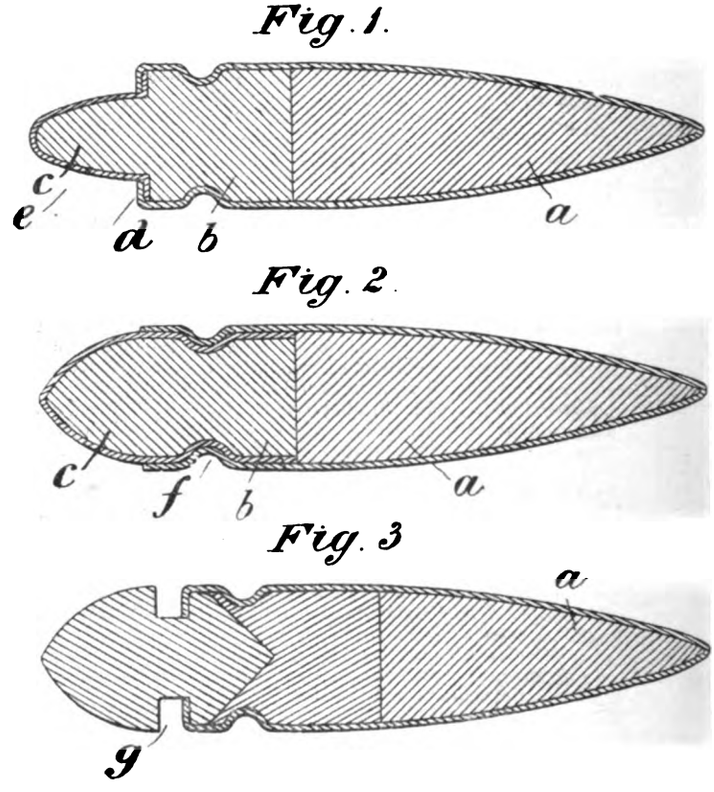
In Figs. 1 and 2 it is shown that the cap lies in the counterbored back portion of the cartridge base *a* so that its top edge bears against the step leading to the smaller diameter hole in which the anvil *c* is situated. By impressing a circular channel *b* in the head of the case a portion of the metal is diverted so that it overlaps the outside of the cap base *d*. In Figs 3 and 4 a different method of turning the metal up may be observed. The projecting portions *e* are left when the cartridge head is manufactured so that they may be formed as at *f* down over the base of the cap after insertion.

In Fig. 5 is illustrated a method of utilizing the gas pressure to increase the tightness of fit of the cap in its chamber. The head of the case does not bear completely on the face of the breech block. When the cartridge is fired the head is deformed and a larger portion (depending upon the load) comes to a bearing. By this means the cap is said to be pressed by the gases hard against the wall of the chamber so that a perfectly gas-tight joint is made. Accepted January 2, 1908.

ENVELOPED BULLETS FOR SMALL-ARMS.

9,876 (1907). King's Norton Metal Co., Ld., T. A. Bayliss, London, and H. Melville Smith, Abbey Wood. The shape of nickel-enveloped small-arm bullets forms the subject of this patent, and the intention of the patentees is to overcome the suction of the vacuum at the rear of the bullet which in flight has a detrimental effect upon velocity. For this purpose they apply to the usually flat rear of these small-arm projectiles a tapering tail such as is shown in the various illustrations here reproduced.

Several forms of tails and attachments are shown, *a* in Fig. 1, being the solid core of the bullet and *b* the separate tail portion



with its tapering rear end *c*. The tail part is attached to the body of the bullet by turning or spinning the edge of the envelope *d* over the shoulder of the part *b* where the taper tail *c* joins. The taper tail *c* is provided with a cover *e* the edges of which are turned in to form a joint with the turned in ends of the bullet cover *d*.

In Fig. 2 the tail portion is shaped differently and is held to the body of the bullet by the formation of the cannelure *f*. In the form shown in Fig. 3 the edge of the body envelope is turned over into the neck *g* in the uncovered taper tail part. This necked portion is, however, not allowed to interfere with the air waves during the bullet's flight because on firing, the gases drive the tail right up to the bullet proper so closing up the neck before the bullet leaves the muzzle.

In one of the other designs shown in the specification the envelope of the bullet proper is extended so that a hollow taper tail is formed; whilst in two others a core running through the bullet is extended rearwards to form an uncovered taper tail. In one of these forms a neck such as *g* in Fig. 3 is left, but it is filled with lubricant which is squeezed out into the bore during the bullet's progress through the barrel.

The patentees are aware that non-enveloped bullets have been made taper-tailed, but their invention consists in the application of tails of this form to enveloped bullets; whilst the object is to obviate vacuum suction and so to bring about an increase of velocity. Accepted Jan. 16, 1908.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 187.—Vol. XVI. APRIL, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

The Problem of Silent Firearms.—A gentleman whose title to fame consists in being the son of Sir Hiram Maxim has startled that section of the newspaper press which cultivates emotional tendencies by announcing the production of a silent firearm. As is usual in such matters the incident may be explained in one or other of two ways, either the whole thing is a joke, or the inventor really supposes that he has found out something valuable. The details are so circumstantially developed that one cannot help inclining to the latter belief. We are told, for instance, that as soon as the bullet has passed a certain point in the barrel a sliding trap door is put into operation by the pressure of the gases, so that their further forward motion is arrested. They are vented afterwards through a small orifice, their emergence being marked by a faint hissing sound. The most ordinary person hearing a gun discharged at close quarters cannot help being struck with the sensation that bottled up energy is being released. The bang of discharge does in reality represent a considerable amount of energy, and to suggest that this energy, which largely consists of gases in rapid motion, can be muzzled and tamed into submission is to betray ignorance, alike of the properties of gases and firearms. The father Maxim made his experiments first and constructed his theories afterwards, so that whether the theories were fallacious or not they had the merit of fitting the facts. Now the facts as regards arresting the motion of the gases in the bore are quite simple and obvious. No rifle barrel in the world could withstand the wave pressure which would be set up by suddenly interposing an air-tight bulkhead at the rear of a projectile after it had gained a material velocity in the bore. The effect would be the same as that of an obstruction placed in the track of the bullet itself. A ·22 calibre rifle barrel an inch in external diameter would be ring bulged by the impact of a 40-grain bullet propelled by the usual charge against a similar bullet lodged in the barrel. The ring bulge would be formed, not directly by the impact of one bullet against the other, but by the checking of the forward motion of the gases when the two bullets come into contact. This is the theory of the subject, and it is based upon facts which will never vary.

The Military Backsight at Bisley.—The National Rifle Association may or may not be the premier authority on military small arms which some of its members profess; but confidence in its own beliefs has led to a bold innovation for the coming season's shooting. Practically speaking the shooter may use in service rifle competitions any kind of backsight which can be attached to the existing arm by knocking out and replacing the existing hinge-pin. Hitherto the belief has been upheld that competitors in service rifle events should be restricted to an absolute dead level of appliances, so that shooting skill alone should decide the winner. The paint-pot, the orthoptic and the vernier were specially sanctioned, but the grandmotherly tone of the legislation went so far as to say that, whilst a man might use black paint or white paint on his sights, he must not blend the two in a neutral mixture. It is difficult to trace

the authorship of the more recent view that rifle shooting, however it may be restricted by rules, can never be limited to a contest between person and person on the range. The advantage will always lie with the shooter who studies his weapon scientifically, with a view to extracting from it the highest standard of behaviour. Colonel Hopton's enthusiasm was undoubtedly largely responsible for the successful introduction of the windgauge slide. This brought into prominence the belief that reasonable variations of existing sight bars might enhance accuracy of shooting without destroying the military value of the weapon. The tour of the Australian team emphasised the importance of extending the same kindly tolerance to aperture backsights, even though placed in the unfavourable situation commonly reserved for the ordinary **v**-shaped notch. The same rule which sanctions the aperture in place of the ordinary **v**, permits the traversing movement of the backsight for wind correction to be effected by means of a screw. These changes have in combination given an immense impetus to the special department of gunmaking which concerns itself with the production of rifle sights. A great variety of devices will undoubtedly be tested, and service rifle competitions at Bisley will lose the sacred traditions associated with cast iron rules with black and white paint for exceptions.

The Destruction of Ancient Cordite.—It is rather unfortunate that the question of the fitness of cordite for service use should again be barred from discussion by reason of litigation, which places many of the points *sub judice*. An influential committee was appointed some months ago to decide the fate of some cordite delivered to the Government, and a promise was made to the House of Commons that members should be taken into the confidence of ministers on the subject. This promise now lacks fulfilment, because the report of the committee might tend to pre-judge the case now pending. The general question at issue is, however, of far greater importance than the fate of a few odd tons of cordite. Large quantities of this explosive have been manufactured since the material became a service explosive, and a relatively small quantity has been actually used under service conditions in the piping times of peace which have since prevailed. Magazines, both on shore and in ships, have held cordite in one form and another for many years; and it is a serious question whether the storage should be indefinitely prolonged subject to periodic examinations of its condition. Explosives represent a form of chemical alliance where the union is due to conditions whose permanence is at the best only relative. There are positive instances of explosives, apparently satisfactory initially, which have suffered serious decomposition in the course of years. Curiously enough this change of condition is far more marked in the case of gelatinized guncotton powders than with nitro compounds into the composition of which nitroglycerine enters. To this extent our own country is more fortunately placed than rival nations who allowed their fears of nitroglycerine to overcome their appreciation of its advantages as an ingredient. However favourable the reports may be of cordite under storage it seems desirable that a time limit of some kind should be applied so that explosive which has reached the age of retirement should pass out of service by being destroyed. Penny wise efforts to work off old material should be severely restricted to explosive falling within the authorised age limit. One knows of many instances where the attempt to use up old rifle ammunition, which ought properly speaking to have been broken up, has ended in disaster. There is in any case the danger that the time limit would lose its efficacy if explosive was allowed an inter regnum period of existence, during which it was nominally condemned for service, but awaiting the finish of its career as a species of second-hand goods. A time limit should be fixed by experts, and once fixed no exceptions should be countenanced.

The Commercial Situation.—The balance sheets whose appearance marks the present period of the year illustrate with singular exactitude the history of the past twelve months. A year ago everything was bad. Coal was dear, every kind of metal was high in price, and manufacturers had got so far out of touch with one another and also with common-sense that they were supplying the consumer at prices which practically involved a loss to themselves. The vitality of the explosives industry is well displayed by the many firms which have survived the serious shock of the recent bad times combined with domestic misunderstandings. At the present moment all the companies which manufacture mining explosives speak confidently of a brighter future. The destructive competition which made last year's results so bad is an unpleasant fact of the past, and everyone seems to admit that the better conditions will remain. The companies which deal with sporting cartridges similarly admit that a better understanding exists between rival members of the trade. This coupled with cheaper metals brightens their future prospects. Coal of course remains dear, and no one seems to be quite sure whether trade prospects are good or bad. The firms whose interests are chiefly wrapped up in Government orders share the belief that times may soon improve. War Office purchases have certainly dropped to a level which is accepted as the minimum scale of peace requirements, and Parliamentary debates have recently emphasised two equally cheering items of information. The first is that the surplus stores which were rendered available by the dismantling of old-type battleships have nearly been absorbed, and the second is the welcome intelligence that the navy has at last asserted its right to purchase its own requirements in the way of guns and ammunition. There was always something anomalous about military officers, having little or no knowledge of naval requirements, acting as middlemen for the navy. The orders were given out in a manner which seldom suited the convenience of the manufacturer, and deliveries at inopportune dates were similarly insisted upon. The manufacturer will probably welcome the partial change of masters and the division of orders which the new arrangement will entail. He may also hope for a more business-like consideration of his necessities as a manufacturer and of his obligations as an employer of labour.

THE CITY EXPLOSION.

CAPT. M. B. LLOYD in his very full report on the circumstances of the accident at Messrs. Dyke's premises in the City states in emphatic language the grounds for disagreeing with the view of the coroner's court to the effect that premises should not be registered for the keeping of explosives unless the local authority agreed that they were suitable for the purpose. The following page from his report clearly expresses his reasons for objecting to the changes in the law suggested during the enquiry:

In the first place, if the change were made in respect of the City, it would have to be granted universally. Many parts of Greater London, of Edinburgh, and of Dublin, are quite as congested as the City itself, and the same applies to other towns. In fact, once admit the principle and it must be made universal; it would be impossible, practically, to draw the line. I take it, therefore, on the broadest basis, that of the whole country.

It has always been held by this Department, that in the case of so highly technical an Act, decentralization is a mistake. The principle of registration, under conditions fixed by the Central Authority, is virtually a licence in fixed form granted to whoever may make application for it, the Local Authority being in the position of distributing such licences of the Central Authority to those who may make application for them. To delegate this licensing power to Local Authorities would be an act of decentralization, and as such, in conflict with the frequently expressed policy of the Department. In the United Kingdom I maintain that there is no cause shown for any change in the law. In Appendix II., I have compiled a complete list of all the accidents on registered premises of which we are cognisant since the passing of the Act in 1875, and an examination of these will show that in by far the greater number of these, where the originating cause lay with the explosives themselves, the accident was due, directly or indirectly to a distinct breach of the existing law for the prevention of such accidents. In other words, that better administration of the existing law would have eliminated a very large number of these accidents, and nearly all the more serious ones. In proof of this assertion I would invite attention to the very small number of accidents which have occurred in London, outside the City, which has nearly 3,000 registered premises. Formerly, under the Metropolitan Board of Works, and, more recently, under the London County Council, this district has, since the passing of the Act, been one in which the administration of the Explosives Act has been consistently good. In the City of London, until the last few years, the same could not be said. In the year 1903, I myself made representations to the Town Clerk as to the unsatisfactory manner in which the Act was administered, and shortly after my complaint the present Inspector was appointed by the Court of Common Council, and has, I have reason to believe, effected a considerable improvement in the condition of the registered premises.

In Appendix III., I have prepared a summary of the accidents on registered premises in statistical form. Seeing that these figures include all loss of life and injury to persons caused by fires on registered premises, and also that they include the figures for all districts, including many in which the Explosives Act, by reason of faulty administration, is almost a dead letter, I think it will be admitted that the record is not such as to form a basis for a reasonable demand for an amending Act.

A gunsmith's business absolutely requires that he shall keep a certain quantity of explosives on his premises for the purpose of loading up cartridges, and further, that he should have at certain times of the year a considerable number of cartridges ready loaded up. To place this right of storage, on which his livelihood depends, upon the whim of a small local body (I have, of course in mind the extension of the proposed alteration to the whole country), would be an arbitrary act which would, I maintain, require a much more serious tale of accidents than the facts allow. The strain of modern life may have deteriorated our nerves to some extent, but not to such a degree as this would seem to imply. It is otherwise with the dealer in petroleum. If he is refused a licence it only shuts him out from a comparatively small portion of his trade, and his business is not ruined as would a gunmaker's be by such a refusal.

Again, I hold that it would be mischievous in that it would doubtless tend to produce an increase of surreptitious and illicit dealing in explosives. Such dealing, not being under observation, would be more dangerous than the properly conducted and legitimate trade as now carried on under efficient inspection, and though the bulk of the trade, and the more law-abiding members of it, who now constitute the great majority, might suffer severely, the number of accidents would hardly be affected.

While on this question of the jury's rider, I should like to point out that the jury was very largely drawn from Mr. Dyke's immediate neighbours. Many of these gentlemen had had their windows broken, one of them at least had sustained slight injuries himself from broken glass, and there is no doubt that in some instances their nerves had been shaken by the explosion and fire. Mr. Dyke and his legal advisers did not see fit to challenge these jurymen although afforded an opportunity by the Coroner to do so. I think, however, that the opinion of the jury should, to a certain extent, be discounted for this reason.

It is to be observed that the damage done to surrounding property by the actual explosion itself was in this case, as in every other which I have personally investigated, comparatively slight. An examination of Appendix II. will further confirm my contention that the amount of explosive which may be kept on registered premises is not so great as is generally liable to cause serious damage to surrounding property. It is practically impossible so to control the trade in explosives as to afford absolute protection from the annoyance, and even the possible danger, caused by broken glass in the event of an explosion. To protect the public to this extent would entail the closing of every factory and almost every magazine and store in the kingdom. Serious

explosions are fortunately of rare occurrence, and, as a rule, the members of the trade are willing as an act of grace to pay without prejudice for any glass which may be broken by explosions. Further than this, I consider that it is impolitic to go. This is a country whose wealth to a great extent depends upon its mines ; it is also a country in which sportsmen are more numerous and more widely spread through all classes than is perhaps the case in any other civilised nation. To bring in unduly repressive laws against an industry upon which so much of the wealth and amusement of the people rests would be as impolitic as I hope I have shown it unnecessary and mischievous.

THE DECOMPOSITION OF NITROGLYCERINE BY CAUSTIC POTASH.

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

THE action of a solution of caustic potash on nitroglycerine was represented, in 1855, by Railton (1) (*Arms and Explosives*, Feb. 1908) as occurring according to the following equation :—

$$C_3H_5(NO_3)_3 + 3KOH = C_3H_5(OH)_3 + 3KNO_3.$$

It is rather a curious fact that, for some 32 years, Railton's equation was considered by chemists to be, in the main correct, *i.e.* that nitroglycerine was decomposed by a solution of potash with the production of potassium nitrate and the reformation of glycerine. It is true that some subsequent workers noticed the presence of nitrite but it was apparently considered to exist in relatively a small proportion. All the workers appear to have accepted as a fact that there was a reformation of glycerine.

Muller and De la Rue (2) remarked upon the formation of nitrous acid in the spontaneous decomposition of nitroglycerine.

Beckerhinn (3), in 1876, carried out some work on the decomposition of nitroglycerine by an alcoholic solution of caustic potash, basing the interpretation of his results on Railton's formula. He added an excess of decinormal alcoholic potash to nitroglycerine, heated the mixture for 10 minutes at 60°–80°C, diluted with half the volume of water, added litmus, and titrated the excess of potash with a decinormal solution of oxalic acid. He quotes results showing nitroglycerine to contain 18·73 per cent. N.

Hess and Schwab (4), in 1877, repeated Beckerhinn's work but could not confirm his results. They noted that when nitroglycerine was treated with alcoholic potash, in the manner described by Beckerhinn, the liquid becomes yellow and rapidly deposits a yellow-brown precipitate. The solution, if diluted with only half its volume of water was so strongly coloured that it was impossible to titrate, with litmus as an indicator. They therefore diluted with four to five times the volume of water, but obtained results which showed from 25 to 26 per cent. N. They further remarked that potassium nitrite is formed in addition to potassium nitrite, seeing that starch-iodide solution always gave a very strong colour even in the most dilute solutions. Formic acid and acetic acid were also noted to be present and in addition a brown body having properties very similar to aldehyde resin.

Matthew Hay (5), in 1887, carried out a very complete investigation on this subject. Hay, in dealing with Railton's work remarks that it is highly improbable that he obtained any glycerine at all, in decomposing nitroglycerine by caustic potash, as he probably mistook for glycerine a syrupy residue consisting of other substances. Hay's own work is of sufficient importance to be quoted at considerable length. When a moderately strong alcoholic solution of potash (1 in 10) is added to an alcoholic solution of nitroglycerine of similar strength, the following phenomena are observed. The first few drops produce an orange coloured precipitate, which on the addition of more potash assumes, with the whole fluid, a deep reddish-brown colour. A large amount of heat is developed amounting almost to ebullition of the alcohol. A strong aldehyde odour is noticeable but no ammonia or accrolein. The fluid separates into two layers. The lower and smaller portion is partly of the nature of a solid precipitate, yet in a great part syrupy and of a very deep reddish-brown colour and containing nearly all the colouring matter formed by the decomposition of the nitroglycerine. The upper layer constitutes the bulk of the fluid and is of a yellowish colour, first muddy and finally transparent. Heat is not necessary to complete the decomposition but in most of the experiments the fluid was boiled over the water bath for several minutes, sometimes to complete evaporation of the alcohol, water being added as the alcohol evaporated. When water is added the syrupy precipitate, in proportion to the amount of alcohol still present, becomes partly or completely dissolved yielding a deep red-brown solution. It was in such diluted solutions that estimations were made of the amount of potassium nitrite formed. This was effected by means of starch, potassium iodide and dilute sulphuric acid, a thoroughly well-boiled 5 per cent. solution of starch, containing 2 per cent. of potassium iodide being employed. The blue colour obtained on the addition of these reagents was compared as regards its intensity, with the colour obtained by a standard sodium nitrite solution. The purity of the sodium nitrite was determined with permanganate and the strengths were 1 in 500,000 and 1 in a million. The solution of decomposed nitroglycerine was diluted with distilled water until on addition of the starch reagent a depth of colour was obtained precisely similar to that given by the strongest solution of nitrite. The method was admitted to be only approximately correct but it was the only one available. The following is an example of the method of analysis. Nitroglycerine (1·1533grms.) was dissolved in 5 c.c. of absolute alcohol and treated with 1·5grms of caustic potash dissolved in 12c.c. of alcohol. The mixture was boiled for half an hour, water being added to replace the evaporated alcohol and the heating continued till the whole of the alcohol was driven off. The fluid was diluted to 30c.c. and 1c.c. was further diluted and employed for the estimation of nitrous acid. A dilution corresponding to 1 of the original nitroglycerine in 620,000 of water was found to con-

tain the same proportion of nitrous acid as the 1 in a million standard solution of sodium nitrite. The nitroglycerine had therefore produced a quantity of nitrous anhydride $\left(\frac{N_2O_3}{2}\right)$, corresponding to 62 per cent. of the anhydride in sodium nitrite, or 34·143 per cent. of the nitroglycerine. The results obtained by this method from eight different samples of nitroglycerine, prepared under very varying conditions as regards composition of acids, etc., gave as an average approximately 35 per cent. of nitrous anhydride. Assuming that nitroglycerine is a trinitrate of glycerol, the results of these analyses correspond remarkably with the supposition that two out of the three parts of nitric anhydride are reduced to nitrous anhydride; for the trinitrate ought theoretically to yield, if so reduced, 33·48 per cent. The possibility of a nitrite group being present in nitroglycerine was negatived by the fact that two of the samples mentioned above, prepared in the presence of urea, were found to yield the same proportion of nitrous acid as the others. Other substances besides potassium nitrite are formed when alcoholic potash acts upon nitroglycerine. Potassium nitrate is present in considerable quantity, and there was reason to believe, from the total nitrogen by Schloesing's method, and from other circumstances, that it corresponded closely to one-third of the nitrogen in nitroglycerine. The presence of potassium acetate and potassium oxalate was proved, and, doubtfully, of potassium formate. There was also a small amount of ammonia and a red-brown resinous body which gives a dark colour to the fluid. Finally there was a very curious and interesting body which possessed the unusual power of forming a very firm jelly with a very large proportion of absolute alcohol. In contradiction to Railton and previous investigators, Hay found no glycerine, or only the merest trace. This was a new and most important fact. To ascertain the presence and nature of these various decomposition products, 6·67 grms. of nitroglycerine was decomposed with excess of potash. The fluid was allowed to stand for a day for the deposition of certain substances dissolved in the hot alcohol. The supernatant fluid, which was of a transparent orange colour, was decanted and the residue was boiled with alcohol, set aside, decanted and added to the previous fluid. The alcoholic fluid contained the excess of potash and the whole of the glycerine, if present. In the deep red-brown residue one would expect to find nearly all the colouring matter and the salts insoluble in alcohol such as potassium nitrate and nitrite. The alcoholic fluid was neutralised with excess of sulphuric acid to precipitate potassium sulphate, and was then fractionally distilled to remove the more volatile substances (alcohol, acetic acid, formic acid) the less volatile glycerine remaining in the retort. The residue in the retort was saturated with barium hydroxide to remove the sulphuric acid, and the excess of barium was then precipitated by carbon dioxide. The filtrate evaporated on the water bath gave 5 or 6 drops of a golden yellow viscid residue. When treated with absolute alcohol, in which glycerine is freely soluble, it hardened and was proved to consist of a barium salt. The alcoholic extract when evaporated yielded one drop of a yellowish syrup more viscid than glycerine and pungent rather than sweet, and gave only the faintest odour of accrolein when heated with acid potassium sulphate. The reddish-brown material when freed from potassium salts weighed 0·08grm. and was of a resinoid character, probably similar to aldehyde resin or caramel. Hay's work showed that Railton's equation was incorrect. When nitroglycerine is being decomposed by caustic potash, nitric acid and glycerol occur in a very active and nascent condition, the one as a powerful oxidising substance, the other as a readily oxidisable substance. As a consequence they act on each other, and two out of the three molecules of nitric acid part each with an atom of oxygen to the glycerol, and this amount of oxygen is sufficient to completely oxidise and break up glycerine, mostly, if not entirely, into certain organic acids, which, of course, will combine with the excess of alkali used for the decomposition. According to another view the caustic potash may be regarded as taking an active part in the decomposition of nascent glycerol, seeing that when glycerine is melted with caustic potash, potassium acetate and formate are produced along with free hydrogen.

In accordance with these views the action of caustic potash on nitroglycerine may be represented as follows:—

(1) $C_3H_5(NO_3)_3 + 3KOH = C_3H_5(OH)_3 + 3KNO_3$

(2) $C_3H_5(OH)_3 + 2KOH = H.CO_2K + CH_3.CO_2K + H_2O + 2H_2$

(3) $3KNO_3 + 2H_2 = KNO_3 + 2KNO_2 + 2H_2O$

or combining these equations—

$$C_3H_5(NO_3)_3 + 5KOH = KNO_3 + 2KNO_2 + H.CO_2K + CH_3.CO_2K + 3H_2O$$

The correctness of the equation is supported, as regards the amount of caustic potash, by the following. According to Railton's equation 1 part of nitroglycerine requires for complete decomposition 0·741 parts of caustic potash. According to the equation just given the proportion is 1 to 1·235. If less caustic potash is used than in the latter proportion, then, if the latter equation be correct, complete decomposition will not occur, and a quantity of nitrous acid will be produced corresponding to the caustic potash employed, and the solution of the products of decomposition will remain neutral until more than the requisite proportion of caustic potash has been added. The following results prove this to be the case.

Weight of N.G.	Weight of Potash.	Yield of Nitrous Anhydride as per cent. of N.G.		Reaction.
		Calculated.	Found.	
1	0·8	21·68	23·23	Neutral.
1	1·00	27·11	28·36	Neutral.
1	1·24	33·48	34·69	v.slightly alk.
1	1·50	33·48	34·69	Alkaline.

(1) *Qr. J. C. S.* (1855), **7**, 222.
(2) *Liebigs Ann.* **109**, 122.
(3) *Sitzungs. Ber. Wien. Akad* (1876), **73**, [2], 235.
(4) *Sitzungs. Ber. Wien. Aked* (1877), **75**, [2], 702.
(5) *Trans. Roy. Soc. Edin.* (1887), 67.

COMPANY REPORTS.

The report and accounts of Messrs. Webley and Scott, Ld. for the year 1907 show that a net profit of £4,059 has been made after providing for bad and doubtful debts, directors' fees, etc., and charging £2,999 for upkeep and depreciation of plant and property. Adding the amount brought forward from the last account, and deducting the half-year's preference dividend paid in August last, viz. £2,931, there remains a balance of £1,141. The sum of £1,000 is transferred to the reserve fund for investment, and the balance is carried forward. The directors point out that the bad results shown in the accounts submitted arise from the very unfavourable condition of the trade in arms and ammunition, coupled with an entire absence of government orders.

The report and balance sheet of the Roburite Explosives Co., Ld., shows a net profit on the year of £4,486 after providing for directors' fees and all other charges. With the amount brought forward from previous accounts, viz. £1,422, there is a total of £5,908 available for appropriation. One-tenth of the year's net profits having been set aside for reserve, in accordance with the articles of association, the sum of £4,939 has been utilised in payment of the year's dividend, viz. 10 per cent., on the cumulative preference share capital. In dealing with the commercial situation the directors mention that though there has been no diminution of sales, profits have been reduced by the necessity for lowering prices to meet the excessive competition referred to in previous reports. Prices have, however, now improved and the directors anticipate achieving better results from this year's business.

The report of Messrs. Armstrong, Whitworth & Co., Ld. for last year states that, after adding £102,944 brought forward, there remains a net profit of £682,699. It is proposed to declare on the ordinary shares a dividend of 3s. per share, free of tax, of which 1s. per share has been already paid as interim dividend. This leaves now payable a dividend of 2s. per share, which, with the payment of £40,000 on the preference shares, will absorb £521,500, leaving £161,199 to be carried forward. The sum of £50,000 has been placed to the credit of the reserve fund, and £50,000 to the fire insurance account. A revaluation of the property of the company has been made, and the result confirms the course adopted in the past with regard to depreciation. The valuation having been taken up to December 31, 1907, no depreciation has been written off for the past year.

The report and accounts of Messrs. Walkers, Parker & Co., Ld., contains a reference to the improved conditions arising out of the reorganisation of the Company's capital during the past year by which the preference shares have been converted into "A" ordinary shares, and the ordinary shares into "B" ordinary shares. The net trading profit made during the past year amounts to £40,782. After providing for interest on debentures and all other head office expenses there remains £16,774. Adding the amount carried forward from the previous account the available total is £37,266. In accordance with the division of profits sanctioned under the new scheme the directors recommend that the "A" shares receive 6 per cent., which will absorb £12,000, the "B" shares getting their *pro rata* proportion, viz. £222. The balance of £25,044 will be carried forward. The directors congratulate the shareholders on the results achieved, and they refer to the unstable conditions introduced by the considerable fluctuations in the price of lead. The chairman, in the course of the proceedings at the annual meeting expressed with due caution the belief that steadier conditions would prevail on the metal market during the present year.

The report and accounts of Messrs. Curtis's & Harvey Ld. for last year showed that as a result of the year's trading, after payment of debenture interest (£19,252), depreciation, and other charges, there is a net profit of £9,747, which, added to the amount brought forward, makes a total of £18,143. This sum it is proposed to appropriate as follows:—£2,000 to reserve, £1,000 to accident reserve, to write £500 off War and Sporting Powder Company's purchase account, £9,160, being two per cent. dividend on the ordinary shares, £5,483 forward. The directors mention that the competition referred to in the last report unfortunately continued during the greater part of the year, but present selling prices are considerably higher than they have been for some time, though the improvement came too late materially to affect the result of the year's business, which also suffered from the increased cost of raw material and coals. They are pleased to report that the prospects of more profitable business are brighter than they have been for many years.

The directors of Messrs. Vickers, Sons and Maxim report that the trading results for the year 1907, although not as good as those of the previous year, may still be regarded as satisfactory. The profit made during the year, after payment of interest on debentures and allowing the usual depreciations, enables the following appropriations, including interim dividends already announced, to be made:—Five per cent. dividend on preference shares £71,250; Fifteen per cent. on ordinary shares, £555,000; Sum written off item £250,000 for goodwill and patent rights, £150,000. The amount carried forward to the next account, viz. £211,076, is slightly less than the amount brought forward from the last account. The directors in their report refer to the considerable increase in the item: interests in subsidiary and connected Companies, viz. £3,399,075, which slightly exceeds the item covering the company's own land, buildings, etc. This is mainly accounted for by the necessity to finance the Beardmore Company during the recent period of monetary stringency, also in connection with the Company's participation in the works in Japan and Italy into which they have entered to preserve their connections with those countries.

THE report and accounts of Messrs. Eley Bros., Ld., show a profit for the year of £11,263, which, added to the amount brought forward from the last account, viz. £4,348, makes a total of £15,611 available. Directors' fees and debenture interest reduce this amount to £11,355. From this the sum of £7,058 is written off for depreciation, the greater part of it from the machinery and plant account. The directors regard this poor result on the year's working as entirely due to the exceptional coincidence of a shooting season below the average, and an abnormal advance in the price of raw materials, and it has accordingly been decided to transfer £3,000 from the reserve fund to provide for the payment of a 2½ per cent. dividend. This will absorb £6,250, leaving £1,047 to be carried forward. The recommendations of the directors were duly passed at the general meeting which took place on the 10th ult. with Mr. Hugh Drummond in the chair. This gentleman has been appointed to preside over the board of directors in the place of Mr. T. R. Bayliss, who has been forced, much to his regret, to resign his position on the board, because he finds that the company's business makes demands on his time which he cannot conveniently satisfy, being resident in Birmingham. Mr. W. T. White has also resigned his seat on the board. Mr. C. C. Eley introduced Mr. Drummond to the shareholders on the occasion of the annual meeting, mentioning in so doing that he occupied several important positions in the commercial world, including the vice-chairmanship of the London and South Western Railway, and the chairmanship of the Southampton Dock Committee. His clear and business-like method of conducting the meeting produced a favourable effect on those present.

ROUND THE TRADE.

Captain Maurice B. Lloyd, late H.M. Inspector of Explosives, has been elected to the vacant seat on the board of Messrs. Curtis's & Harvey Ld.

Amongst the list of newly registered companies is Ammonal Explosives (1908) Ld., which has been formed to acquire and take over the existing business having a similar name.

The report of the Comptroller and Auditor General on the army ordnance factories, which has just been issued, makes mention of the fact that the Sparkbrook Factory, which was sold to the Birmingham Small Arms Co., Ld., changed hands at the price of £110,000.

The *Law Journal* published in its issue of the 7th ult. an interesting article on the legal aspects of Rifle Club meetings on Sundays, by Lord Justice Lindley, which his Lordship sums up as follows: "The conclusion, therefore, of the whole subject is that rifle practice on Sundays during divine service is forbidden by the ecclesiastical law; and that it is restricted at all hours by the Acts of 1625 and 1781, which have been already noticed. In other words, rifle target practice on Sundays by parishioners in their own parish except during the hours of divine service is perfectly lawful, provided care is taken to prevent the rifle range from becoming a place of public entertainment and amusement on payment of money. But rifle ranges open on Sundays to non-parishioners are prohibited by the Act of 1625, and if open to the public on payment by the Act of 1781."

The National Rifle Association, in the leaflet which it issues at this time of year, giving notice of alterations and additions to the programme for the Bisley meeting, mentions that the War Office pattern miniature rifle may be used in competitions open to military miniature rifles. This was the case last year. Consequently the notice must be read as an intimation that the National Rifle Association have abandoned the mistaken policy adopted in their recent miniature meeting of barring the War Office rifle, and so giving their own weapon a clearer field. It is generally understood that pressure has been exerted from high quarters to secure this return to the traditional attitude of independence which one expects as a matter of course from the National Rifle Association.

At the annual meeting of the Association of Municipal Corporations held at the Guildhall on the 18th ult. Sir Homewood Crawford, the City Solicitor, moved, "that in the interest of public safety it is urgently necessary that the Explosives Act, 1875, should be amended, with a view to affording greater facilities to local authorities for exercising proper control; and that the Secretary of State for the Home Department be informed accordingly." He said that at the present moment the subject was under the consideration of the Home Secretary, and it had been brought prominently to his notice in consequence of the very serious explosion which occurred within 100 yards of the Guildhall, and was attended by destruction of property and loss of life. The great blot of the Act was that the local authorities were merely registration authorities and not licensing authorities. The proposal of the Corporation was that the practice should be assimilated to that relating to the storage of dangerous compounds, so that the local authority should have the power of absolute refusal or of imposing conditions. If the applicant were discontented he had the right of appeal to the Home Office. The important towns and cities represented there that day had just as much danger from explosives as the City of London. In the case he had mentioned the premises were in accordance with the regulations as regards storage, but they were not desirably situated for such a purpose. If the Corporation had had the power which they ought to have had the premises would never have been licensed, and there would have been no loss of life and property. He asked the association to support the Corporation in the endeavour to secure the necessary amendment of the law. The proposition was seconded by the Mayor of Gateshead and carried unanimously.

The New Explosives Co., Ld. have issued a circular dated the 2nd ult. giving notice of an increase in the price of shot gun cartridges to correspond with the prices now being quoted by the cartridge case manufacturers. It is mentioned that a new catalogue is in course of preparation, and will be issued in due course.

A long and complicated report of proceedings in connection with the ownership of certain Letters Patent, covering what is known as the Rexer automatic gun, appeared in the *Times* of the 5th ult., the dispute being mixed up with the question of Royalties, the bankruptcy of Mr. Snell, and the liquidation of the Rexer Arms Co., Ld.

Messrs. B. R. Banks & Co., Ld. have forwarded to this office a copy of their 1908 price list for wholesale and export only. The firm work through agents in the different centres of consumption, and their slugs are of various shapes, including the popular wheatsheaf or hour-glass pattern, which combines the benefits of a long bearing surface in the rifling and a small frictional resistance during its movement along the bore.

Notice was given in the patent journal of the 11th ult. that patent No. 22,894 granted to John Robertson for single-trigger guns has become void through non-payment of renewal fees. The patent had only another year to run, but this sudden demise was hardly foreshadowed by the complicated series of amendments which were applied for some while back as a result of the adverse decision give in the Courts rather more than a year ago.

The Illustrated Official Journal of the 11th inst. contains, in the supplement devoted to reports and trade marks cases, the proceedings before Mr. Justice Warrington on December 17th last, in connection with the action of Vickers, Sons and Maxim, Ld. against the Coventry Ordnance Works, Ld. for alleged infringement of patent. The proceedings seem mainly to have been devoted to arranging for the withdrawal of the action, which was in the end dismissed with costs.

A copy of the report of an enquiry held by Major Alured B. Denne, chief inspector of explosives in the Transvaal, into the circumstances of an accident which occurred at the British South African Explosives Company's factory, No. 3 Modderfontein, on the 6th of May last, has been received at this office. It is an elaborate document, very fully illustrated with views of the wreckage and injured buildings, together with plans showing their arrangement, and a host of other material which shows that Major Denne is carrying out the work of his department with due regard to the traditions formulated by the late Sir Vivien Majendie, and duly reproduced in the work of his successors, and those carrying on the important duties of explosives inspection in different parts of the world.

According to the *Western Morning News* there is a prospect of the National Explosives factory being re-started for the manufacture of explosives. These works were closed last June, all the capital having been used up. Though the works were the second largest in the country for the manufacture of explosives, they went by the board in consequence of keen competition. For three years this commercial war in explosives went on, and resulted in the West Cornwall works abandoning the manufacture of explosives and discharging 450 employees. Though the works have been closed since last June, the machinery and plant have been kept in perfect condition and work could commence immediately. There is a great deal of Cornish money in the concern, and the feeling is that the Cornish mines, in which is used a large amount of explosive, could help to resuscitate an important industry by placing all their explosive orders with the company, and thereby largely benefit the county.

LECTURES TO YOUNG GUNMAKERS.

No. XLIX.—ACCURACY IN ·22 CALIBRE AMMUNITION.

THERE are two ways of regarding the natural diversities of the grouping obtained from miniature rifles. The one is to assume that the irregularities in a vertical direction are due to variations of velocity, and sideways more or less to wind; and the other is to regard wild shots in whatever direction they occur as the result of pure cussedness. The number of published experiments which have aimed at settling this disputed point must be very small, if indeed any records of such exist. Successful manufacturers who possess the key to the production of regular shooting ammunition are averse to showing the means by which their success is attained. They are at times not entirely guiltless of the charge of mystifying enquirers who desire to learn their secret. Their unwillingness to impart information may possibly arise from the circumstance that while they know how to produce a certain result they are not always sure themselves of the cause; consequently there is more than one reason for adopting a non-committal attitude.

The experiments which form the basis of the present lecture constitute a most valuable exception to the rule in question. The object was to ascertain whether the high and low shots of a 50-yards group, made with ·22 ammunition fired from a rifle firmly fixed in a rest, were noticeably the result of variations from the mean velocity. To carry out the requisite observations a rifle of known accuracy was fixed in alignment with a screen containing the parallel rows of wire, through which the bullet could not pass without breaking one of them, and so causing a record of velocity to be made on the chronograph. Fixed immediately behind the wire screen was an ordinary card target. Each shot was separately spotted through the telescope, so that one obtained the velocity and position of each shot fired. Three kinds of ammunition and two rifles were used in the experiments, and when the targets were changed care was taken to place the new one in the position that the old one had occupied.

Five diagrams were obtained under the above conditions, Figs. 1, 2, and 3 were made with a particular rifle using three kinds of cartridges designated respectively X, Y and Z. Figs. 4 and 5 illustrate the shooting of a different rifle using X and Y ammunition. A special check upon the elevation of the shots striking the target was provided by taking note of the particular wire which each bullet severed in passing through the velocity screen. The wires in question are ·15 of an inch apart, this extreme closeness being necessary with bullets of ·22 inch calibre. When two wires were severed the upper one was recorded.

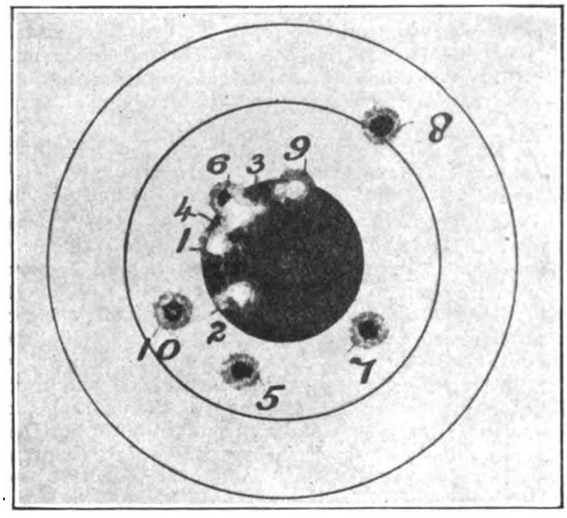


FIG. 1. TEN SHOTS WITH RIFLE A AND SMOKELESS AMMUNITION X.

Serial Number of Round.	Position of Wire Broken by Bullet.	Velocity over 50 Yards.
8	1st	1115 f.s.
6	4th	1086 ,,
1	5th	1084 ,,
9	4th	1080 ,,
4	4th	1077 ,,
10	8th	1046 ,,
7	9th	1017 ,,
5	11th	1008 ,,
3	4th	1005 ,,
2	8th	1004 ,,
	Av.	1052 f.s.

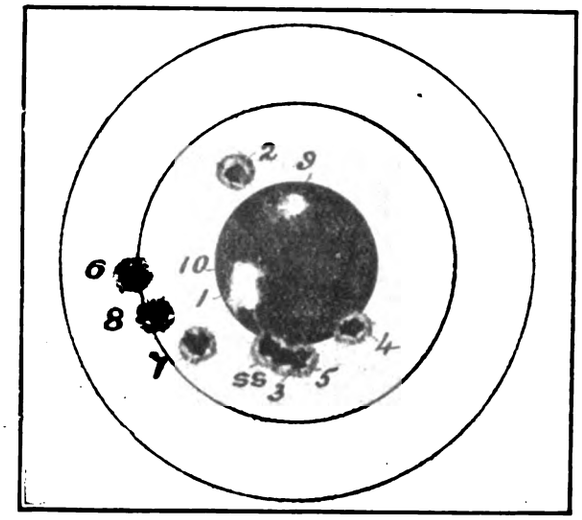


FIG. 2. TEN SHOTS WITH RIFLE A AND SMOKELESS AMMUNITION Y.

Serial Number of Round.	Position of Wire Broken by Bullet.	Velocity over 50 Yards.
10	6th	1040 f.s.
5	10th	1031 ,,
9	4th	1020 ,,
8	7th	1013 ,,
6	7th	1013 ,,
2	2nd	1013 ,,
7	8th	1004 ,,
1	7th	1003 ,,
4	8th	995 ,,
3	10th	995 ,,
	Av.	1013 f.s.

The practical purpose of the present lecture will be to examine each diagram in turn to ascertain whether any definite relation exists between the elevation of the shots on the target and the velocities recorded. Fig. 1, for instance, contains a fairly close group with a high shot, No. 8, giving decidedly the highest velocity. Considering that the distance of shooting was 50 yards the group is extremely compact. Consequently one must regard rounds 1, 3, 4, 6 and 9 as striking at practically the same angle. All of these except No. 3 have about the same velocity. No. 3 is, however, 80 f.s. less than the others, and this certainly suggests that something in the region of a 100 f.s. difference does not exercise much effect on angle at 50 yards. Rounds 2, 5, 7 and 10 certainly rank as low in relation to the rest of the group, and they appear in the lower section of the table in which the velocities of the Fig. 1 series of shots are arranged in descending order.

Turning next to Fig. 2 a very similar style of diagram appears. Round No. 2 obviously struck with the highest elevation, yet its velocity is exactly the average of the series. Round No. 9 also struck distinctly on the high side, but its velocity was 20 f.s. lower than round No. 10, which struck with average elevation. On the other hand No. 3 struck lowest, and gave the lowest velocity; but this does not carry us much further, because No. 5 went through practically the same hole and made the second highest velocity in the series. The natural tendency of shots to disperse around the mean trajectory seems to be more pronounced than the assumed law that high velocity shots strike high, and low ones correspondingly beneath. Moreover groups are generally as broad as they are high, whilst the conditions should give greater height than width when the amount of wind is immaterial.

Fig. 3, which displays the behaviour of a black powder brand of ammunition, shows a slightly different characteristic form of grouping. There is a diminished tendency on the part of a proportion of the shots to form a close group, while the outlying ones seem to have pursued a course of their own. Smokeless powders show the one close group and the stragglers, whilst black powder displays a more miscellaneous dropping of shots over the whole space covered, with frequent wide intervals between consecutive rounds. Here again an extraordinary feature of the Fig. 3 group consists in the circumstance that the change from smokeless to black ammunition has caused a lateral shifting of the place struck by the shots of no less than an inch. That the rifle had not shifted in the rest was proved by firing a subsequent series with smokeless cartridges, the change of ammunition bringing the group back to the bull. Rounds 8 and 9 which struck highest on the target, unfortunately missed the wire screen altogether. Consequently their velocity is not known. The rest of the shots lie within a small vertical band about half-an-inch high by rather over an inch wide. This can have nothing to do with wind, because the weather observations show that the slight wind which prevailed at the time was blowing in the direction of the shooting, and not across. The consistent elevation displayed in the Fig. 3 diagram certainly suggests that the velocity readings should be regular. This is perfectly carried out in the results shown, and the Fig. 3 target favours the view that even velocity produces regular elevation. Common-sense, however, suggests that the causes which led the bullets to strike right and left might equally have forced them upwards or downwards. Before passing to the diagrams which were made with a different rifle it

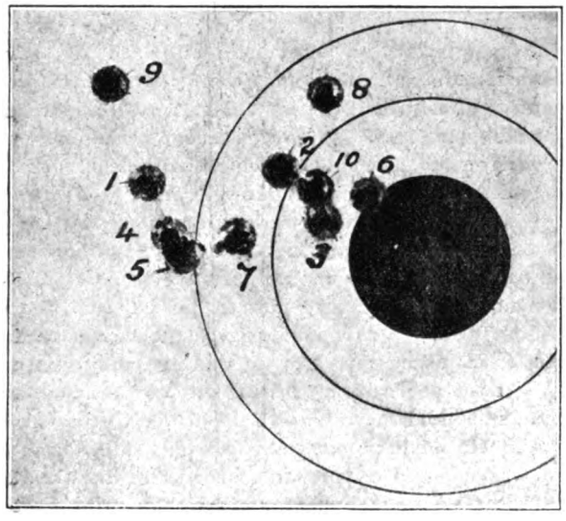


FIG. 3. TEN SHOTS WITH RIFLE A AND BLACK POWDER AMMUNITION Z.

Serial Number of Round.	Position of Wire Broken by Bullet.	Velocity over 50 Yards.
4	5th	1056 f.s.
5	6th	1054 ,,
2	3rd	1040 ,,
1	4th	1038 ,,
6	4th	1038 ,,
3	5th	1038 ,,
7	6th	1030 ,,
10	4th	1030 ,,
8 and 9 (records lost).		
	Av.	1041 f.s.

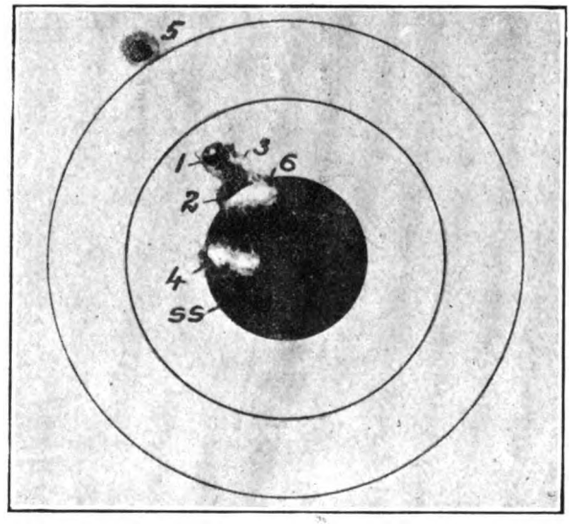


FIG. 4. SIX SHOTS WITH RIFLE B AND SMOKELESS AMMUNITION X.

Serial Number of Round.	Position of Wire Broken by Bullet.	Velocity over 50 Yards.
6	3rd	1023 f.s.
4	7th	1004 ,,
1	3rd	1000 ,,
3	4th	1000 ,,
2	4th	988 ,,
5 (record lost).		
	Av.	1003 f.s.

may be worth while pointing out that Fig. 1 shows a perfect average elevation, Fig. 2 a slight tendency to strike low, and Fig. 3 a similarly slight tendency on the high side. The mean velocities of the three series are 1052 f.s., 1012 f.s. and 1041 f.s. respectively. Thus, comparing one group with another, the lower velocity shows a lower average elevation, a result which is always confirmed when comparing cartridges giving widely different velocity. The Fig. 4 experiments show that the change of rifles has caused X ammunition to drop 49 feet in velocity, and Y ammunition about the same, viz. 56 f.s.

Fig. 4, according to the grouping should give exceedingly even velocity results. This is true of the rounds of which records were obtained, but the high shot, No. 5, unfortunately missed the wires. The table displays no special tendency on the part of the high and low shots in the group to show concordant velocity results.

Fig. 5 is more interesting than the preceding group, because it shows two dropped shots, the velocity of the higher being duly recorded. In actual figures it travelled to the target at 960 f.s., as against 956 f.s. the average of the series. Rounds 3 and 4, which struck at the top of the group, had the lowest velocity of the series, viz. 956 f.s. and 940 f.s. respectively. Here seems to be evidence that a difference of 1·2 inch in elevation has occurred entirely independently of and even somewhat in opposition to the accompanying velocities. No consistent relation apparently exists between velocity and angle when the variations are such as would occur between round and round of a brand of good cartridges. One knows that velocity is amongst the factors which influence angle, but the experiments here recorded appear to suggest that it has not the importance which the shooter would be inclined to suppose when he gets an unexpectedly high shot, or an unexpectedly low one.

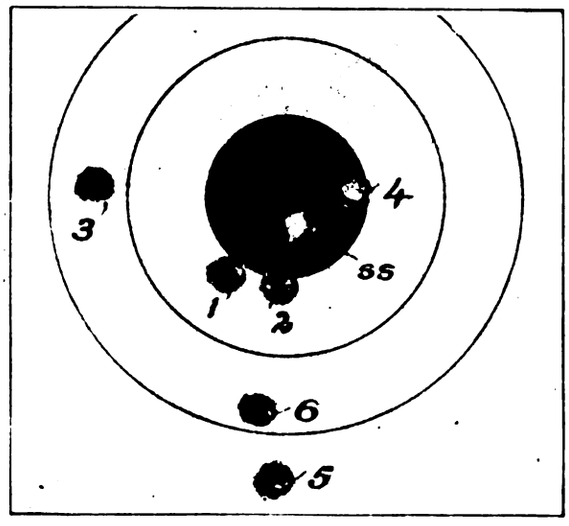


FIG. 5. SEVEN SHOTS WITH RIFLE B AND SMOKELESS AMMUNITION Y.

Serial Number of Round.	Position of Wire Broken by Bullet.	Velocity over 50 Yards.
2	10th	962 f.s.
1	10th	960 ,,
6	15th	960 ,,
4	6th	956 ,,
3	6th	940 ,,
5 (record lost).		
	Av.	956 f.s.

THE TREATISE ON SERVICE EXPLOSIVES.

ABOUT the middle of last month a reader of this journal wrote asking whether we could purchase on his behalf a copy of the 1907 edition of this handbook, and to make quite sure that the long overdue edition was still unpurchasable a messenger was sent to the official publishers, and extraordinarily enough it proved to be on sale. Though the War Office is a publisher of books on a fairly large scale it does not follow the ordinary custom of sending out review copies, with the result that one only hears that a new book has been issued by such chances as the above. The new edition of the *Treatise on Service Explosives* contains a quantity of new information concerning tests of the stability of explosives which will prove of great interest to the manufacturers.

A somewhat amusing aspect of the situation is that a considerable portion of a volume, ostensibly devoted to service explosives, should treat of the manufacture and behaviour of saltpetre powders which have for long ceased to figure as service explosives. Clearly the production of official text books, though it is given over to extremely capable men, nevertheless falls into the hands of those who are quite unable to devote requisite attention to the cares and duties of authorship.

In the interests of journalistic etiquette and law, it is necessary to call attention to the fact that on pages 75, 89 and 90 illustrations appear which have been reproduced from the columns of this paper without permission or acknowledgment. The interest which had been aroused by the successful installation of nitroglycerine and guncotton plants at Waltham Abbey working on the separation process led to our applying for permission to describe them in these columns. There was no necessity to break into the Waltham Abbey factory, nor to burgle Sir Frederick Nathan's private house and extract the necessary documents from his bureau. An unromantic entry was made by the front door, official permission previously obtained having smoothed the way. To do justice to the valuable material which had been gathered a highly skilled draughtsman was engaged to prepare shaded drawings, suitable for process reproduction, from the blue-print sketches supplied by Sir Frederick Nathan. The work was so well performed that its repetition for the Government treatise would have been a waste of labour. An application on the usual lines would not only have secured a most cordial permission to reproduce the illustrations, but, in acknowledgment of the graceful reception which our own request received, the original drawings would have been supplied, in order that the engravings in the text book would not be marred by the faults which inevitably occur when making reproductions from printed illustrations. The publishing trade knows to its cost that liberties cannot be taken with the law of copyright, but the War Office disregards these risks, relying upon the kindly disposition of its friends.

INTERIOR BALLISTICS.

REVIEW.

"Balistique Intérieure" by Le Commandant P. Charbonnier. A volume of the Encyclopédie Scientifique. Published by Octave Dion, Paris. 360 pages. Price 5fr.

IN the introduction the author states that: "Interior ballistics has for its object the study of the mechanical phenomena which take place in a gun barrel, during the very short time which elapses, between the inflamation of the igniter and the ejection of the projectile from the muzzle." To the student of this subject, "gunpowder is any substance which, when excited in a certain manner, emits gases" and develops forces when enclosed in vessels. The object of interior ballistics is to determine experimentally the law of this emission and to estimate the forces, which develop at each instance and to calculate by analysis the effects produced on a projectile submitted to these forces. The book is divided into three parts, viz. (1) Pyrostatics, which treats of the combustion of powders in closed vessels, (2) Pyrodynamics or the combustion of powders in guns and the expansion of the gaseous products, and (3) Interior Ballistics properly called, which takes the equations established in the previous parts and applies a process of rigorous analysis to their integration and discussion. It is stated that the theory presented is of so general a character that the earlier work on the subject, *i.e.* the theories of Sébert and Hugoniot, Moisson, Mata and Hoesen, may be considered as special cases of this treatment.

The maximum pressure developed in closed vessels is proportional to the density of loading and the specific force of the explosive. The time-rise of pressure from ignition to maximum, in the closed vessel, is generally regarded as a geometrical function of the granulation and the velocity of combustion. Present artillery powders are horny masses which are supposed to burn in parallel layers and at a rate proportional to an exponential function of the pressure. Thus successive superficies of a burning grain should bear a definite relation to one another. Charbonnier points out that this can at the best only represent a limiting state, never realized in practice, because it assumes that the superficies of all the grains of a charge become ignited at the same moment and that there are no cracks in the grains or variations in the rate of burning of the parts of a grain. As a matter of fact, in practice, the grains of a charge are not ignited all at once, nor is the whole superficies of a grain inflamed at the same moment. Moreover there are bubbles or cracks in all gelatinized artillery powders and these give rise to new burning surfaces during combustion.

Charbonnier makes the time-rise of pressure depend on two new functions, viz. (1) *a function of form*, the relation of the burning superficies at any moment considered, to that of the initial superficies, and (2) a constant for each powder, termed *vivacity*, the relation of the initial superficies of a charge, to that of its volume. Mathematical analysis then shows that the point of maximum rate of time-rise of pressure and also its value per unit of time, give data which permit the evaluation of these two new functions and also the exponent of the pressure function of the velocity of combustion. In this way the variants are made to depend on empirical results obtained by actual firing in closed vessels rather than on *a priori* considerations. With the values obtained from firing in closed vessels, the fundamental problem in a gun is simple, depending as it does on established thermodynamical relations. The secondary problems are, however, numerous. Charbonnier considers 22 variants which affect more or less the firing result. These are made to appear in the various expressions but their values depend on empirics rather than on mathematics. In this way it is thought that the subject of interior ballistics is placed on a more secure and practical basis. Although the more important functions are fixed by firing results, the expressions do not lose their usual form, in fact the treatment is highly academical. All readers of interior ballistics should study this work.

APPLICATIONS FOR PATENTS.

FEBRUARY 17—MARCH 21, 1908.

3,510. Targets. C. H. Ross.
3,526.* Stereoscopic Telemeters. C. Zeiss.
3,555. Cartridge Making Machinery. W. B. Challen.
3,586. Ordnance Projectiles. H. C. L. Holden.
3,587.* Ordnance Breech Mechanism. H. C. L. Holden.
3,634.* Elevating Gear for Barrel Recoil Ordnance. Fried Krupp.
3,654. Rifles. T. R. R. Ashton.
3,888. Toy Pistols. B. Parkinson.
4,002. Automatic Targets. W. Hadley.
4,046.* Explosives. F. W. Bawden.
4,128.* Forming Cartridge Rope from Explosive Gelatine. H. Auchu.
4,136.* Ordnance Shells. Rheinische Metallwaaren und Maschinenfabrik.
4,245.* Ejector Mechanism for Small Arms. H. White and N. Dryden.
4,254.* Breech Loading Guns. E. Schneider.
4,347. Device for Rifle Butt Scoring. P. Clausen.
4,381. Repeating Rifle. A. Weingardt.
4,468.* Charges for Detonator Casings. L. Wöhler.
4,614.* Automatic Firearms. P. Mauser.
4,634.* Cartridge Carriers. A. A. Woodhouse.
4,707. Automatic Work-feed Motions. Birmingham Metal and Munitions Co., Ld., and F. Bennett.
4,713.* Single Trigger Gun. R. F. MacMichael.
4,822. Silent Rifles. W. G. Potter.
4,913. Targets. A. R. Jeffrey.
4,932. Firing Guns by Electricity. H. Treude.
4,999. Construction of Floating and Fixed Structures, Guns, Projectiles, etc. W. J. Stewart.
5,141.* Automatic Gun Cartridge Feed. Hotchkiss Ordnance Co., Ld.
5,142.* Firing and Cocking Mechanism for Automatic Guns. Hotchkiss Ordnance Co., Ld.
5,192. Cast Steel Armour Plates. W. A. Hartley.
5,205. Ordnance Breech Mechanism. A. T. Dawson and G. T. Buckham.
5,211. Ordnance Breech Mechanism. A. T. Dawson and G. T. Buckham.
5,213.* Ordnance Recoil Apparatus. L. M. Fuller.
5,217.* Gun Sights for Moving Targets. D. B. Harris.
5,282.* Detonating Percussion Caps. L. Lavaillant.
5,379. Rifles. W. G. Potter.
5,500. Range Finders. Sir W. H. M. Christie.
5,558. Automatic Small Arms. J. Eastwick.
5,659. Disappearing Targets. F. Q. Gale and F. J. H. Phillips.
5,683. Guns. H. J. Neville.
5,865. Magazine Rifles. A. W. Rogers.
5,889. Ordnance Loading Apparatus. A. F. Petch and F. Duncan.
5,951. Automatic Arms. R. J. W. Brown.
5,955. Shot Guns. A. S. Purdey.
5,966.* Armour-piercing Projectiles. J. L. Brown.
5 992. Rifle Backsights. J. E. Martin.
6,030.* Shot Guns. J. Hagmüller.
6,041.* Cap Making Machine for Toy Pistols. L. Mauny.
6,074. Rifle Sights. J. T. Peddie.
6,079. Electric Fuses. A. J. Jordan.
6,108. Sights for Rifles. F. J. H. Phillips.
6,151. Targets. A. N. Whitney.
6,268. Ordnance Projectile. H. Stanbridge.

6,282. Ordnance Ammunition Supply. A. F. Petch and F. Duncan.
6,352. Mechanical Machine Gun. H. C. Heide.
6,353. Bullet Trap and Target Holder. H. G. Brain and F. E. Stephens.
6,354. Bullet Trap and Target Holder. H. G. Brain and F. E. Stephens.
6,358.* Automatic Discharge Device. A. Müller.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

FEBRUARY 27—MARCH 19, 1908.

COMPILED BY HENRY TARRANT.

2,883 (1907). **Aiming Device.** F. Mitchell, London. The mechanism described in this patent for registering the accuracy of aim of a rifle gives very similar results to the apparatus well known as the "sub-target" machine. A pointed rod is caused to follow the movement of the rifle and to prick a miniature target at the spot corresponding to that which the bullet would have struck on the target proper had a shot been fired. Accepted Feb. 5, 1908.

3,389 (1907). **Running out Gear for Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. A normally inactive compressed air system is adapted to be substituted for the hydraulic system in the event of the latter becoming inoperative. A check valve is introduced to control the air pressure regulating the speed of run back. Accepted Feb. 11, 1908.

3,498 (1907). **Loading Apparatus for Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. A loading cage in which the ammunition is carried in a tilting holder which travels during the passage of the cage along its guide rods in an upright position, but is afterwards caused to assume an inclined position to bring the lower or projectile end co-axial with the bore of the gun. Accepted Feb. 6, 1908.

3,602 (1907). **Loading Apparatus for Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. In the loading apparatus described in the patent above No. 3,498, 1907, the powder charge holder is permanently tilted relatively to the projectile tray. The powder charges are permitted to drop out successively instead of rolling out laterally. The projectile tray is arranged so that the projectile may easily be removed if necessary by hand tackle. Accepted Feb. 13, 1908.

3,716 (1907). **Aiming Device.** F. Mitchell, London. An improved form of the rifle aiming apparatus described in patent No. 27,538, 1906, is dealt with in this specification. The aim indicator is connected with the rifle by means of flexible cords, and it is arranged that a beam of light or a shadow may indicate the movement of the rifle when aiming. Accepted Feb. 13, 1907.

4,226 (1907). **Loading Gear for Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. In an ammunition hoist for heavy ordnance the projectile tray and the powder charge receptacle are hinged. The latter opens at both ends so that the charge can be loaded into the top when the receptacle is in an upright position and may be withdrawn from the bottom when the holder is tilted at the end of its travel. Accepted Feb. 13, 1908.

4,439 (1907). **Potassium Chlorate Explosives.** M. A. G. Himalaya, U.S.A. To avoid the formation of crystals a siccative oil such as linseed is used instead of water in the manufacture of chlorate of potash explosives. To the plastic mixture is added an oxygen carrier, starch preferably, whilst a second oxygen carrier such as manganese dioxide may also be used. It is claimed that the combustion of this explosive is very rapid, due to the intimate admixture of finely powdered chlorate of potash and oil. Accepted Feb. 24, 1908.

4,823B (1907). **Automatic Rifle Breech Mechanism.** P. Mauser, Germany. A firing pin arresting device is introduced to prevent the striker reaching the cartridge until the breech casing has returned and is in proper position relatively with the barrel. The device consists of a transversely moving slide operated by the recoiling and returning parts. Accepted Feb. 20, 1908.

4,823c (1907). **Automatic Rifle Breech Mechanism.** P. Mauser, Germany. A spring sear releasing arm is combined with the sear and trigger to prevent the rifle being fired unless the breech is properly locked. The spring sear releasing arm and sear are disengaged when the breech block moves back so that the sear is able to catch the firing pin without hindrance. Accepted Feb. 20, 1908.

4,923 (1907). **Automatic Small Arm Mechanism.** T. C. Johnson, U.S.A. The buffer adapted to take up the shock of recoil on the barrel described in patent No. 3,717, 1907 is improved to enable it properly to withstand the very heavy shock when high power cartridges are used. Accepted Feb. 27, 1908.

4,974 (1907). **Humane Cattle Killer.** G. L. Derriman, London. In order not to frighten an animal to be slaughtered the barrel of a revolver is arranged at right angles with the butt so that the operator may stand by the side of the beast. The weapon is fired by means of a wire running through the butt. Accepted Feb. 6, 1908.

5,010 (1907). **Rifle Sight Protector.** E. C. R. Marks, London. (Agent for *M. E. Sutherland, Canada*). (*See Selected Patents*).

5,134 (1907). **Manufacture of Hollow Projectiles.** S. O. Cowper-Coles, London. The metal of which a shell is to be made is melted in a crucible by passing through it an electric current of sufficient density. The crucible is then rotated at such a speed as to leave a hollow of required dimensions in the centre of the metal. The rotation is continued until the metal has cooled sufficiently to retain the shape imparted by centrifugal force. Accepted Feb. 27, 1908.

5,666a (1907). **Automatic Rifle Mechanism.** K. A. Braüning. To adapt an automatic rifle for use with blank ammunition provision is made for the fitting of a special form of breech closing head. This may easily be removed when the proper head for ball cartridges has to be attached. Accepted Feb. 27, 1908.

7,837 (1907). **Ammonium Nitrate Explosive.** N. Ceipek, Austria. From 85 to 88% of ammonium nitrate is mixed with from 15 to 12% of an exciter such as an aniline nitrate. Trinitrotoluene enhances the disruptive effect without impairing the great safety which the explosive is claimed to possess in fiery mines. From 6 to 10 parts of trinitrotoluene to 94 to 90 of the mixture above are quoted as proper proportions. Accepted Feb. 6, 1908.

9,869 (1907). **Automatic Rifle Mechanism.** Capt. U. Marga, Belgium. In order to regulate the movement of the breech block of automatic fire arms some of the gases are guided through a vent in front of the chamber, back to a brake which acts upon the breech block. Shock is eliminated and gas pressure behind the bullet is it is claimed not lost. Accepted Feb. 27, 1908.

10,377 (1907). **Lock Mechanism for Sporting Guns.** W. J. Whiting, Birmingham. (*See Selected Patents*).

10,739 (1907). **Ordnance Mounting.** A. F. Petch, R. Redpath, and T. A. Petrie, London. In the ordnance of the kind which can be drawn rearwardly out of bearings in the mounting, the trunnion bearing locking gear block is, according to this patent, held in place by a second block at the rear capable of being locked to the carriage on both sides of the line of pressure by giving it a partial turn. Accepted Feb. 27, 1908.

11,607 (1907). **Electrical Sighting Apparatus for Ordnance.** Lieut. A. T. Dawson and G. T. Buckham. London. A small motor adjacent to the sighting apparatus of each gun operates in synchronism with motors at the fire control station. The sighting apparatus is set to the required range or deflection from the station by means of this fully described electrical mechanism. Accepted Feb. 26, 1908.

13,814 (1907). **Ordnance Sighting Apparatus.** A. F. Petch, and F. Duncan, London. A connecting rod is arranged to attach the pointer to a stationary part of the range dial. One end of the rod is on a pivot which can be set in different positions for different muzzle velocities and to compensate wear in the barrel. Accepted Feb. 13, 1908.

14,950 (1907). **Percussion Fuse.** King's Norton Metal Co., Ld. and T. A. Bayliss, London, and E. Whitworth, Birmingham. A simplified form of the fuse mechanism described in Patent No. 3,966, 1906, in which the detonator carrier is capable of a rotative movement to bring it into line with the firing pellet needle. Accepted Feb. 6, 1908.

15,238 (1907). **Automatic Ordnance Mechanism.** N. Sjöquist, Sweden. By means of a limb and a guide the barrel of automatic ordnance may be reciprocated in an oblique or lateral direction so as to scour a position extending on either side of a point aimed at. Accepted Feb. 20, 1908.

15,552 (1907). **Small Arm Cleaning Apparatus.** H. J. Haddan, London. (Agent for *P. E. Aird, U.S.A.*). A cleaning rod attachment or pull through is formed with a head adapted to carry the cleaning rag through the barrel. The rear of the head is undercut so that when the device is drawn back the rag does not bind. The puckers in the rag gather up in the inclined space formed at the back of the head. Accepted Feb. 13, 1908.

15,884 (1907). **Manufacture of Small Shot.** F. E. Reddy, U.S.A. Suitable apparatus is described for making shot by a new method. Molten lead in globular form is dropped into a moving mass of plumbago such as is known commercially as "East Indian graphite." Accepted Feb. 27, 1908.

16,332 (1907). **Percussion Fuse Mechanism.** S. D. Cushing, U.S.A. A device similar to a combined hammer and striker of a shot gun lock is held in a percussion fuse in a cocked position by two bolts which are removed by centrifugal force to allow the striker to take up a position with its point in alignment with the percussion cap. Accepted Feb. 6, 1908.

16,492 (1907). **Smokeless Gun Powder.** G. H. Wadsworth, Lyndhurst. To increase the bulk, or decrease the density, of a smokeless gun powder the grains are treated to render them of bone-like or porous nature. Finely ground barium nitrate in the proportion of 2½ is added to one portion of the explosive treated with solvent to make it plastic. After drying the mixture is treated with water to dissolve out the barium nitrate, grains of the desired porosity being left. Accepted Feb. 6, 1908.

17,148 (1907). **Safety Device for Automatic Pistols.** J. Tambour, France. (*See Selected Patents*).

17,794 (1907). **Target Apparatus.** Major A. Miller. Falling target apparatus is described which is adapted to drop under the shock of impact of a bullet. The mechanism is carried by a metal plate on the back of the target itself to enable the target to be easily changed and to allow of rigidity. Accepted Feb. 13, 1908.

19,874 (1907). **Cartridge Making Machinery.** F. Werner, Germany. An adjusting and sorting device for delivering cartridge cases in proper order to another part of the machine consists of a drum with an inclined bottom in which is a curved piece of metal arranged below an inclined rotary feeding disc parallel with the inclined bottom. Accepted Feb. 6, 1908.

20,931 (1907). **Chlorate of Potash Explosives.** M. A. G. Himalaya. U.S.A. In patents No. 4,439, 1907 and 3,179, 1907 a chlorate of potassium explosive has been described in which water is not used for mixing. By the present invention 70 to 78 parts of chlorate of potash are mixed with 16 parts of starch and 6 to 9 parts of heavy mineral oil. To increase the quickness of the explosive binoxide of manganese may be added. Accepted Feb. 13, 1908.

21,777 (1907). **Barrell Recoil Ordnance.** Fried Krupp, A.-G., Germany. To decrease the weight of barrel recoil ordnance with air running out gear the compressed air reservoir which contains the recoil brake and compressor is made to carry the slide for the barrel. Among other improvements may be mentioned the introduction in the horizontal trunnions of a pressure gauge communicating with the air reservoir. Accepted Feb. 6, 1908.

26,129 (1907). **Ammunition Waggon.** Fried Krupp, A.-G., Germany. A protective shield for tip up ammunition waggons is arranged so that when the door of the waggon is closed it forms a back rest for the gun crew and when the door is open and the waggon tipped up it augments the protected space. Accepted Feb. 6, 1908.

26,261 (1907) **Manufacture of Explosive.** P. Winand, Germany. In the manufacture of the "sprengal" type of explosive formed by mixing a combustible constituent with a liquid oxygen vehicle the patentee proposes to use as the latter tetra-nitromenthane (CN_4O_8). Such an explosive is claimed to possess the advantages inherent in bodies of an organic nature consisting of nitrated substances only. Accepted Feb. 6, 1908.

26,386 (1907). **Ordnance Firing Mechanism.** A. T. Dawson, and G. T. Buckham, London. Firing mechanism of the slip lock type dealt with in patent No. 8,286a, 1905 is modified. It may according to the present specification be operated either indirectly, by a trigger on the gun cradle or other non-recoiling part, or directly by the ordinary trigger. The latter has a double action to provide for firing from either side of the gun. Accepted Feb. 21, 1908.

26,515 (1907). **Armour Piercing Mechanism.** Fried Krupp, A.-G., Germany. The manufacture of armour destroying projectiles is facilitated by making the hollow space taper towards the projectile point. This tapered space is filled with wood or other material to support the explosive charge and prevent ignition on impact. After the shell has passed through the plate the fuse ignites the charge. Accepted Feb. 27, 1908.

27,079 (1907). **Sighting Gear of Heavy Ordnance.** Fried Krupp, A.-G., Germany. The attachment of sighting apparatus with a curved bar used with heavy ordnance is rearranged and improved. It is particularly applicable to heavy high angle fire guns. Accepted Feb. 20, 1908.

27,273 (1907). **Percussion Fuse Mechanism.** Fried Krupp, A.-G., Germany. In a known construction of safety mechanism for percussion fuses a number of balls are arranged to hold apart the limbs effecting ignition until they are removed by centrifugal force. The present patentee inserts another part which moves relatively with the balls so that they are allowed to quit the safety position in the ball race gradually, one at a time. Accepted Jan. 23, 1908.

1,957 (1908). **Steel Bullet.** Prof. F. W. Hebler, Switzerland. A solid steel bullet for small bores is provided with a wrapping of paper or fabric which is adapted to take the rifling and revolve the bullet. The wrapping falls away when the bullet leaves the muzzle of the gun. Accepted Feb. 20, 1908.

SELECTED PATENTS.

LOCK MECHANISM FOR DROP-DOWN SPORTING GUNS.

10,377 (1907). W. J. Whiting, Birmingham. The reconstructed mechanism described in this patent for "Anson and Deeley" or "box" locks of hammerless drop-down guns or rifles, introduces a method of utilizing a spiral main spring not only for cocking the tumbler carrying the striker, but also for throwing it to discharge the cartridge. Wear or inaccuracy of fitting between parts is automatically taken up and the mechanism may be applied to locks of the side plate pattern.

The mechanism is illustrated in the drawings reproduced. The tumbler or hammer *a* is pivoted as shown in the action body *b*, and works in conjunction with the usual form of sear *c* and trigger *d*. The cocking lever or "dog" *e* is pivoted in the forward part of the action at *f* and its nose *g* works in a slot in the knuckle *h* of the fore-end. In this manner it is operatively connected with the break-down barrels and is as will be readily seen is turned on its pivot during the opening and closing movements of the gun.

The cocking dog *e* carries, in the hole *i* in its centre, the plunger *j* illustrated in detail. This plunger is fitted with the strong spiral main spring *l* which is constantly under compression and forces the plunger against the suitably shaped face *n* on the toe of the tumbler *a*.

Assuming the parts are in the position illustrated in Fig. 2, when the barrels are dropped down for reloading, the cocking dog *e* is, through its engagement with the fore-end, forced round on its pivot. During its travel the plunger *j* is made to wipe along the face of the tumbler extension, so that the tumbler is forced backwards on its pivot to the position illustrated in Fig. 3. There it is held by the nose of the sear *c* and when the gun is reclosed the plunger is carried back by the cocking dog to its original position leaving the hammer cocked as in Fig. 1. When the trigger is pulled the sear releases the hammer which is forced by the pressure of the spring propelled plunger below its pivot at the point *n* to drive its striker forward to fire the cartridge.

It is claimed by the patentee that this arrangement facilitates the cocking action considerably, and the use for two purposes of the single mainspring simplifies the construction of the lock besides allowing for automatic compensation of wear and obviating the necessity for accurately fitting and finely adjusting the various parts. It is also adapted so that the whole of the mechanism may be bodily removed from the lock to facilitate dismounting and assembling. Accepted Feb. 27, 1908.

Fig. 1

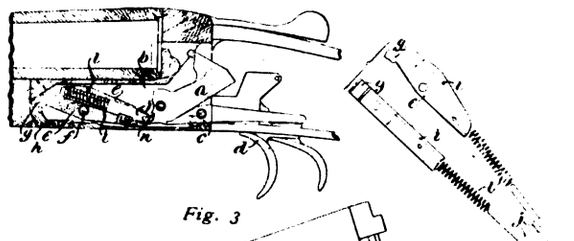


Fig. 3

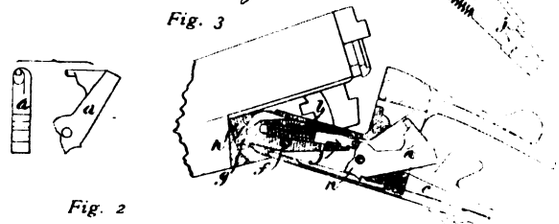
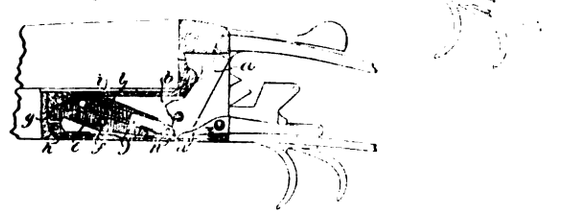


Fig. 2



SAFETY MECHANISM FOR AUTOMATIC PISTOLS.

17,148 (1907). J. Tambour, France. The safety mechanism described in this patent is of the sort which has been applied by the inventor to various types of arms. It is now adapted to automatic pistol mechanism and, as a glance at the appended drawings will reveal, is of that kind which is always operative except when the trigger hand grasps the grip of the weapon.

The part *a* shown in the illustration is adapted to the butt of an automatic pistol and in the normal position locks the sear *b* through its projection *c* (Fig. 1). When the hand of the firer grasps the butt the lever *a* is pressed inwards to the position shown in Fig. 3, and when the trigger is pulled the sear *b* is free to be turned on its pivot to release the hammer *d*.

Fig. 2 illustrates the method provided by the patentee for releasing the cocked hammer by hand without operating the lever *c* separately. All that is necessary is to overcock the hammer (Fig. 2) and pull the trigger. The overcocking removes the safety projection from the sear *b* and the pulling of the trigger turns the sear to release the hammer. Supposing the hammer should slip from the thumb in uncocking no harm can be done because the projection *e* of the lever *a* is arranged to prevent the hammer completing its forward movement by engaging with the bent *f* in the underside of the hammer (Fig. 4). Should the projection *e* fail to do its work in this respect the sear catches the hammer before it reaches the striker by engaging the bent *g* (Fig. 4) providing pressure on the trigger has been removed. Immediately after the trigger has been pulled when actually firing the parts occupy the position shown in Fig. 3. The safety lever takes up its inoperative position and the sear is turned by the trigger pull sufficiently to allow the hammer to drop right down and cause the striker to fire the cartridge. Accepted Feb. 27, 1907.

Fig. 1

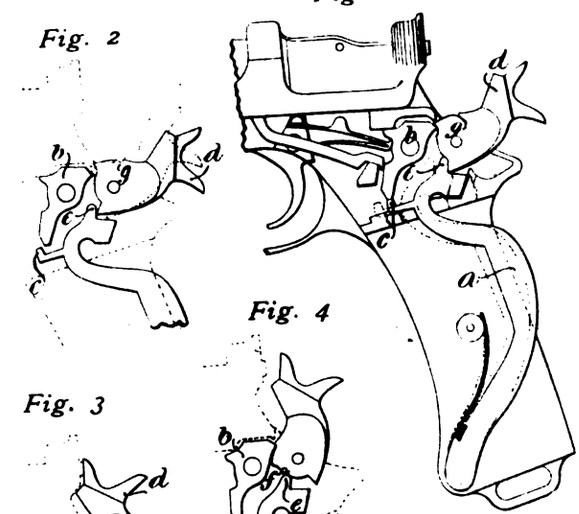


Fig. 2

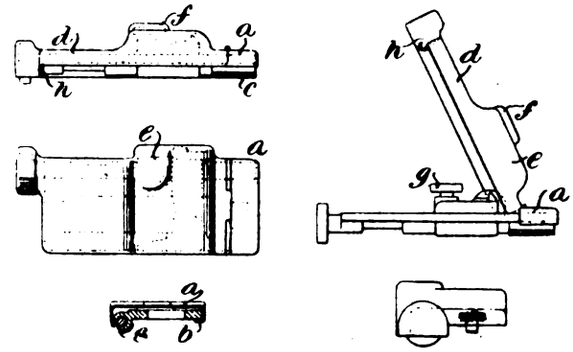
Fig. 4

Fig. 3

RIFLE BACKSIGHT PROTECTOR.

5,010 (1907). E. C. R. Marks, London. (Agent for *M. E. Sutherland, Canada*). In specification No. 5,254, 1905 was described a back sight provided with lateral and vertical screw adjustments and a bar locking nut. In the present specification the sight protector here illustrated is dealt with.

The protector is made in two hinged parts the rear *a* fitted with inturned flanges *b* and *c*, and the forward part *d*. As is shown in the cross section the flange *b* on the rear part is properly shaped to take over the side of the leaf carrying the vertical adjustment screw. The bulged portions *e* and *f* of the part *d* are provided to receive the bar of the sight with its lateral adjustment parts and the set screw *g* by means of which the bar may be locked on the leaf. An extension *h* accomodates the head of the vertical adjustment screw.



The protector is placed in position by first sliding the rear end *a* over the back of the sight and by folding the forward portion *d* down into the position illustrated. A spring catch *h* holds it against accidental displacement. Accepted Feb. 27, 1908.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 188.—Vol. XVI. MAY, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

A Penetration Test.—*Country Life* deserves all the credit which is due to originality for having collaborated with Messrs. Blank, the noted soap manufacturers to conduct experiments concerning the penetrative power of shot charges, by firing against slabs of soap, considerable in size and uniform in consistency. The idea was of course to secure, at a non-prohibitive cost, a sufficient area of penetrative material capable of registering the behaviour of practically the whole of the pellets of an ordinary shot charge. Such a test, although not necessarily providing information new to experts, is undoubtedly capable of correcting a number of popular misconceptions which shooters and shooting writers are apt to pass forward from generation to generation. A person using an ordinary penetration testing rack would find that his results were criticised, because he only caught the central pellets of the charge and failed to take note of the outer circle of pellets, whose force must, according to these authorities, be estimated before the efficiency of the whole charge can be arrived at. If the penetration rack were moved away from the centre, other objections would in due course be forthcoming, and great ingenuity is necessary to devise tests for the class of mind which searches more earnestly for error than for truth. The soap test has definitely shown that while penetration varies considerably between one pellet and another, the stronger pellets do not mass themselves in the centre or in any other special part of the pattern. Once again in the history of sporting gunnery it has been proved that the much deformed pellets have least penetration, whilst those that go in deepest have mostly retained their roundness of shape.

The Conversion of Martini Rifles.—The more one hears about the agitation against the conversion of Martini rifles the more apparent it is that the subject is not worth the attention which has been devoted to it. This view of the question is supported by the arguments which have been brought forward in support of the policy of the two rifle associations. It has been pointed out that the rifle club movement was not initiated for the benefit of the gun trade, but that it is run on patriotic lines. The problem of securing a supply of rifles for use by clubs and individuals with whom money is scarce has always been a difficult one, and the lack hitherto of a satisfactory solution has in many directions checked some of the progress which would otherwise have been made. Trade in small rifles has, however, increased enormously as a result of the demand which the extension of rifle shooting practice on the club system has produced. In other words the gunmaker and the dealer must be satisfied with the business that can be picked up by the way, and they must not adopt the attitude of persons having monopolist rights. When all is said and done the rifles have been converted by gunmakers, and gunmakers continue doing the work. It is inconceivably illogical to blame the shooting associations because certain representatives of the gunmaking industry are either philanthropists, or are ignorant of the true cost of the work they are performing. Neither explanation fits in with a common-sense view of the facts. The War Office is within its rights in selling discarded weapons which are the property of the nation, with a view to further public service being made of

them. Whether the price at which they are purchased from the war department is eighteen pence or eighteen farthings each is absolutely immaterial, so long as there is no doubt that the large majority of those which are ultimately re-sold in a converted form produce results of value to the nation at large. There is certainly a great deal in Mr. Peddie's argument that progress of design should be encouraged rather than risk retrogression by reverting to discarded patterns. The practical answer to this complaint is that the converted Martini rifle is by no means so perfect or so cheap that it will oust competing arms of higher price, which are or at least should be better adapted for the purpose in view. The Martini system of rifle action possesses certain inherent defects, which the process of conversion not only cannot obliterate, but in some respects accentuates. Competing rifles of good design should always prove an attraction to the keen marksman. If it is true that the contract price which has been fixed for the conversion process does not allow a fair profit to the manufacturer then so much the better for those who are engaged in selling weapons produced by ordinary means. A starvation price tends to cause scamping of work and general deterioration of quality. The rifle shooting fraternity is so good a judge of what is best that it would throw over tomorrow the manufacturer who supplied an inferior article. Consequently the undue cheapness, if such it be, of the converted weapon may indirectly result in teaching shooters to appreciate first-hand goods, even though they cost a little more.

The Paris-London Gun.—Because Jules Verne lived to see the *Nautilus* an accomplished fact inventors of a certain class have claimed a hearing for their absurdist boasts. The idea of a gun which would be capable of firing a shot several hundreds of miles is so attractive to the public mind that when a gentleman, of the name of Simpson, recently announced that he could attain a velocity up to 30,000 feet per second, the hoax was seized upon with the usual avidity, the more so as a real live Colonel had given it his blessing and approval. On one occasion only, in the course of the existence of this journal, has it been our fate to come into direct contact with one of these wonder workers of ballistic science. The methods of the invention process were laid bare, and they proved extremely interesting. No gun, no workshop, nothing more than a slip of paper and a stump of pencil were necessary to perform record-breaking achievements by way of velocity, penetration and striking power. A capacity for rapid mental arithmetic carries the invention process even further than the slip of paper and the stump of pencil. If ordinary guns are made 30 feet long there is no difficulty in assuming the existence of one a hundred feet long, and if this fails to give the desired answer a stroke of the pencil converts feet into yards. The ideal explosive is of course the one which contains a uniform pressure along the bore. There is no need to decide what shall become of the pent-up gases when the shot leaves the muzzle—an ideal is an ideal, and it must be treated with due respect. Therefore the problem is reduced to the simple basis of so much force acting over so many feet of gun length. The projectile may have any assumed diameter and weight, and simple arithmetic converts force over distance into muzzle energy and muzzle velocity. Ranging power and penetration are a little less easy to handle, since simple arithmetic must here give place to the use of tables and formulæ. As these are not extended beyond the range of present-day practical conditions, the inventor having reached thus far is justly entitled to frame his own methods for converting internal into external ballistics. This sketch of an actual interview has in no way been aided by the imagination, as can be proved by referring to a letter in a leading newspaper in which the general essence of the invention was described, the War Office being incidentally held up to approbrium for their pigheadedness in refusing to enquire into so *promising* a scheme.

The Theory of Pointed Bullets.—A tribute of thanks is due to Mr. Jones for having communicated the chief results of his work during the past two years on the problem of pointed projectiles for the benefit of others interested. Very early in his labours he ascertained that chronographic methods of registering a succession of time intervals for the passage of a bullet through a series of screens whilst no doubt giving a true indication of the value of air resistance over the particular distance covered by the tests, are nevertheless utterly misleading as an index of the bullet's behaviour in travelling over a half mile or so of range. The only proper test of air resistance is to note the angle of elevation used in long range shooting, and to eliminate by calculation all the other factors that influence the result. It requires a rifle shot of considerable ability to carry out the practical shooting part of the programme, and a man trained to science to interpret the results which are obtained. Those who can combine both functions are necessarily few in number, but when the manufacturing difficulty of getting the necessary sample shapes made is taken into account it is not surprising that our knowledge on the pure theory of the subject has not advanced very rapidly. Mr. H. R. A. Malloch, F.R.S., member of the Ordnance Committee, some time ago communicated a paper on the subject of air resistance generally and pointed bullets in particular, to the Royal Society, in which he defined with wonderful acumen the mathematical aspects of the problem which the new bullet has brought to the front. His paper has not hitherto received the attention it deserves, partly perhaps because its proper understanding is rendered exceedingly difficult by a quite incomprehensible number of printing errors. However, patient delving has enabled the mathematical deductions to be fully investigated in the light of practical shooting tests at the range with the result that the common stock of knowledge on a most important subject has undoubtedly been advanced. It must of course be clear that the public to whom these things appeal is extremely limited. On the other hand the whole country has a stake in the successful issue of the efforts which are being made on all sides to assist in the production of the best possible form of pointed bullet for the use of the national forces.

NITROGLYCERINE YIELDS.

THE Journal of the Society of Chemical Industry in its issue of the 16th March contains the interesting and valuable paper on nitroglycerine and its manufacture which Lieut. Col. Sir Frederick Nathan, R.A., the Superintendent of the Royal Gunpowder Works at Waltham Abbey, and his assistant Mr. W. Rintoul, read before that Society on the 3rd February, 1908.

The services which Sir Frederick Nathan has rendered not only to the Explosives industry, but to the public, by perfecting methods of safety cannot be overestimated. At the meeting Capt. Lloyd bore testimony to this, and it is no doubt in accordance with the rules of the society which eliminate from the publication of discussions all complimentary remarks, that what he said has not been published. Although Mr. Oscar Guttmann pointed out that a number of the contrivances introduced by Sir Frederick Nathan lacked novelty, the installation for the manufacture of nitroglycerine at Waltham Abbey is on the whole a pattern of safety and efficiency.

With regard to that portion of the paper which deals with the efficiency of the plant, it would be well to remember that a Government factory differs from those of the trade inasmuch as it is not worked for a profit. The question of cost which is pre-eminent with the trade, especially in times of keen competition is of minor account with a factory owned by the State. We see that in the discussion as printed, the remarks of Mr. Otto Hehner have been omitted. That eminent chemist criticised the manufacture of nitroglycerine as a whole from the point of view of yield, expressing his surprise that, whilst theoretically 100 parts of nitroglycerine should produce 246·74 parts of nitroglycerine, the yield in the earlier processes was usually somewhat under 200%, the more modern yields being between 200 and 210%, rising gradually to 220, and ultimately 229% as mentioned by Sir Frederick Nathan.

As described in the paper under review, the yield is determined by the relation of nitric acid to sulphuric, the relation of the quantity of acid to the quantity of nitroglycerine and the strength of the acids. Mr. Hehner thought that a more efficient dehydrating agent could be found than sulphuric acid, but he did not suggest that such more efficient dehydrating agent would be cheaper. He likewise evidently was not aware that the yield is calculated by taking the weight of the nitroglycerine as used, which includes always a percentage of moisture, frequently as much as 1½ per cent., and the weight of nitroglycerine when finally washed and purified. Now although nitroglycerine is only sparingly soluble in water there is unquestionably a loss due to its solubility. The lower nitrates, *i.e.*, mono- and dinitro-glycerine are very soluble in water, and it is the production of a larger percentage of these, when the acids are less concentrated, which was the main cause of the lower yields in the earlier processes.

The introduction of fuming sulphuric acid, currently known in the trade as oleum, to which Sir Frederick Nathan correctly attaches great importance, dates back some years prior to its adoption at Waltham Abbey as pointed out by Mr. de Mosenthal. This important modification in the manufacture of nitroglycerine cannot be regarded as one of invention, having been determined solely on economic grounds. For many years the fact that the strength of the acids, *i.e.*, the absence of water, was a great determining factor in the yield was well-known. It was also no secret that the proportions between nitric and sulphuric acid, as well as the proportions between the acids and the quantity of glycerine, played an important part, but the price of fuming sulphuric acid was prohibitive, and in many cases the cost of nitric acid was so high as to make it impossible to use to economic advantage the percentage mixtures which would give the best yield. This is even true to-day when a number of factories find it pays better not to get the maximum yield attainable, because the ideal acid mixture costs more than the additional quantity of nitroglycerine obtained is worth.

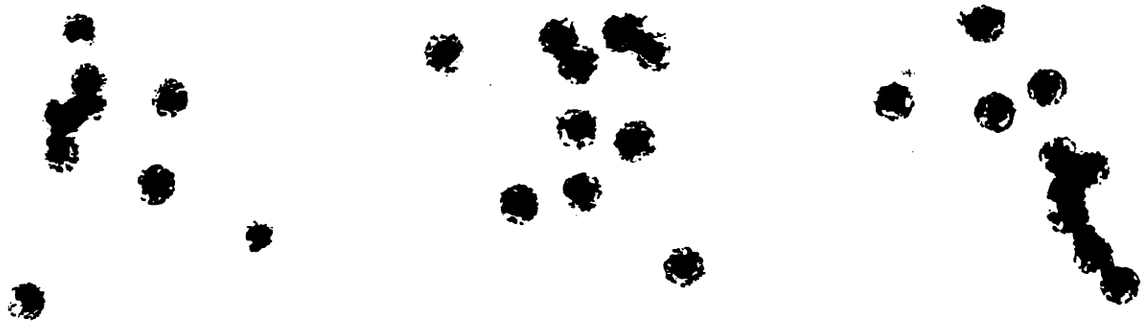
The introduction of fuming sulphuric acid dates from the time when the contact process had been sufficiently developed to be practicable. Even then for a time the question of royalties impeded the development, and even subsequently it was only factories with a large productive capacity which could face the capital outlay connected with the erection of contact plants. A number of factories whose geographical position renders it impossible for them to obtain fuming sulphuric acid at a price, including freight, which compares advantageously with the price at which they can obtain acids of lower strength—factories the productive capacity of which renders it impossible for them to have their own contact system—are now working and will no doubt have to continue to work on the old lines. Other factories again, situated where they can only obtain nitric acid at very high prices, find it impossible to work with the ideal acid mixtures.

In fine it must never be forgotten in judging industrial processes that their aim, as far as the trade is concerned, is not to attain to scientific perfection. The one and all absorbing factor is economy. Factories are not scientific laboratories, they are run for a profit. On the other hand, as far as the explosives trade is concerned there can be no doubt that economy must be set aside when it is a question of safety. This, however, is a matter which has never been disputed for the Home Office inspectors constantly admit that the difficulties of their task are greatly lessened by the cordial co-operation they receive from the trade.

Treatise on Service Explosives.—Mention was made last month of the fact that use had been made in this Treatise of illustrations which had been reproduced from the columns of this journal without the usual permission having previously been obtained. An explanation entirely satisfactory to ourselves has since been received, which disassociates the War Office from any connection with the incident, and shows it to have arisen entirely as a result of personal omission.

THE ·22 SHORT LEE-ENFIELD.

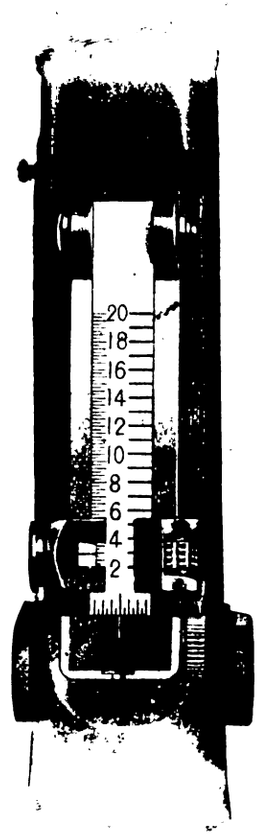
THE recent issue by the Birmingham Small Arms Co., Ld., of a ·22 calibre edition of the new pattern, Mark III., short Lee-Enfield rifle is a matter which has been passed over with very little expert comment, although it is of considerable intrinsic importance. It is, for instance, important that shooters should realise that the manufacture and sale of service pattern rifles fitted with miniature calibre barrels marks the disappearance of the Morris tube. Almost as soon as the details of the Mark III. short rifle had been approved for manufacture the contractors received permission to issue concurrently ·22 calibre editions of this rifle. The weapon in its service form is much better adapted for miniature range practice than the long Lee-Enfield, because of the modern system of backsight with which it is fitted. It is by no means certain that the army, and others concerned with the teaching of recruits, will always incur the large expense involved in using rifles for miniature range practice carrying a magazine and all the other details of the full power weapon. Where money is a secondary consideration compared with the desire to reproduce service conditions as closely as possible the full military model will doubtless be used. The best rifle for firing a particular class of cartridge is obviously the one which is primarily designed with that end in view, and this suggests that the future may bring forth a rifle representing a cross between the War Office miniature and the Service rifle in use for the time being.



Three 10-shot diagrams, each with different ammunition, at 50 yards with B.S.A. ·22 L.E. Short Rifle.

The short ·22 Lee-Enfield rifle, which the Birmingham Small Arms Company have loaned in connection with this article, carries out the adaptation process with the ingenuity to which we are accustomed. The bolt head, the extractor and the barrel have all been modified in design to suit the altered conditions. The shooters who used the rifle at the recent miniature meeting in Bunhill Row spoke very highly of it, and in a similar fashion our own tests confirm the favourable opinion formed. The three diagrams which are here reproduced constitute a high testimonial to the shooting power of the rifle. They are about on a par with other diagrams which were made on the same occasion. More powerful target cartridges would no doubt show superior results, but those here depicted practically represent the limit of accuracy to which the ·22 cartridge can show that a ·22 rifle can be made to give good shooting without adopting the supposed necessary evil of a short chamber.

From the point of view of the gunmaker or the private individual the existence of the short Lee-Enfield rifle with ·303 barrel is of very little importance because of its inferiority for range shooting purposes to the old long model as used at Bisley and elsewhere. The short rifle is thus of purely academic interests, and it would not be worth anybody's while to purchase it merely as a museum model. When fitted with a ·22 barrel the situation is entirely altered, since it then forms a thoroughly sound and practical miniature weapon. It carries the new military backsight, which has been worked out with immense trouble at Enfield. The notch in the backsight is formed like the letter U and it is supposed to combine with a knife-blade or Nelson column foresight. It is a matter much in dispute



whether this combination is equal to the older V and barleycorn. Hythe and Enfield believe it to be superior, others think that a change for the worse has been made merely in order to have something different. The ·22 Lee-Enfield offers in many respects a better opportunity than a full power rifle would afford for shooters to decide most of these questions on a practical basis. Thus it becomes a weapon of decided commercial importance, for which a certain amount of demand should exist.

The accompanying illustration shows the general style of the backsight with the peculiar worm nut, which holds the sliding piece at any given elevation and is theoretically capable of rotation for making fine adjustments. An entirely favourable verdict upon this new sight mechanism cannot for the moment be given. It tears the flesh from the fingers rather than worm up and down its appointed path. The charger clip guide is another feature of the new rifle which can be studied at leisure by the possessor of the model under notice. It forms a complete bridge, standing up rather high above the bolt way; but, barring a tendency to scrape the finger joint when removing the bolt from the rifle, it does not appear to get in the way. These criticisms of course apply only to the rifle under notice so far as it represents a strict reproduction of the Government model. As a miniature rifle suited for club use it has many points in its favour, especially its military character, and the 8lbs. 12oz. of weight, which gives the shooter something solid to grasp.

CERTAIN CHEMICAL DECOMPOSITIONS OF NITRO-GLYCERINE.

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

REFERENCE has been made to Hay's (1) work on the decomposition of nitroglycerine by caustic potash. (*Arms & Explosives*, April 1908). Hay also investigated the action of certain other chemical compounds, of which the following are the more important.

Action of Ammonia. Similar action, but not so energetic as potash. With excess of ammonia no immediate decomposition takes place. The mixture remains colourless and no precipitate is formed. On boiling for an hour, and replacing the ammonia as it evaporates, the solution assumes an even deeper reddish brown colour, than is the case with caustic potash. The amount of nitrous anhydride formed was equal to 34·5 per cent. of the nitroglycerine used, and was exactly similar to the proportion obtained by means of fixed alkali. The ammonium nitrite formed, would therefore appear to undergo but little decomposition, under the conditions in which it is placed. This is probably due to the presence of free ammonia, the low heat employed, or perhaps highly concentrated alcohol hinders the decomposition of ammonium nitrite.

Action of Alkaline Carbonates. The same reaction was observed, with a yield of nitrous anhydride equivalent to 35·34 per cent. A 5 per cent. alcoholic solution of nitroglycerine, when boiled with an excess of potassium carbonate, is completely decomposed in an hour.

Action of Sodium Phosphate. This salt was added in concentrated aqueous solution to a 1 per cent. alcoholic solution of nitroglycerine. After three or four minutes heating, decomposition began, and the tint of the solution gradually deepened to an orange red. At the end of 1½ hours heating, 13·5 per cent. of nitrous anhydride was obtained in the solution, and it was observed on diluting with water, that a considerable amount of nitroglycerine was precipitated. Sodium phosphate appears, therefore to act upon nitroglycerine in much the same manner as the alkalies, only very much less powerfully.

Action of Sodium Chloride. An excess of a concentrated solution of sodium chloride was mixed with a 1 per cent. alcoholic solution of nitroglycerine and heated for 35 minutes. No change of colour was observed, and the nitrous acid did not amount to more than a fraction of 1 per cent. Starch reagent yielded no blue colour with the fluid until sulphuric acid was added. There was, therefore, a trace of nitrous acid present as nitrite. The addition of caustic potash proved that sodium chloride has not decomposed the nitroglycerine and lost nitrous acid by decomposition or evaporation.

Action of Hydrochloric Acid. 1·6 c.c. of strong acid were diluted with 2 c.c. of water and added to 10 c.c. of a 1 per cent. alcoholic solution of nitroglycerine. After heating for half-an-hour, a trace of nitrous acid was found to be present. Half the volume of the fluid was heated with caustic potash and yielded 13·5 per cent. of nitrous anhydride Hydrochloric acid, had, therefore, decomposed 39 per cent. of the nitroglycerine, but whether with the formation of nitrous acid, it was not possible to say. Hydrochloric acid in large excess, decomposes nitroglycerine much more slowly than alkalies, and not much more quickly than sodium phosphate.

Action of Sulphuric Acid. 1·5 c.c. of strong acid were diluted with 1 c.c. of water, mixed 10 c.c. of a 1 per cent. alcoholic solution of nitroglycerine and heated for half-an-hour. The merest trace of nitrous anhydride was present in the fluid. One half of the fluid when treated with caustic potash yielded nitrous anhydride corresponding to 29·7 of the nitroglycerine. The sulphuric acid had, therefore, decomposed 11·3 per cent. of the nitroglycerine employed, and would appear to act less energetically than hydrochloric acid.

Action of Sulphuretted Hydrogen. According to De Vrij (2), (*Arms & Explosives*, Feb. 1908), an ethereal solution of nitroglycerine is readily decomposed by sulphuretted hydrogen with copious precipitation of sulphur. Two 10 per cent. solutions of nitroglycerine were prepared, the one in alcohol, the other in ether. A rapid stream of sulphuretted hydrogen was passed for 15 minutes, and in the case of the alcoholic solution, for 15 minutes more at boiling point. Not the slightest trace of decomposition was observable. There was no change in colour, and a complete absence of sulphur, nitrous acid and decomposition products. Nitroglycerine was abundantly precipitated from both solutions on the addition of water. De Vrij's

experience was therefore due to using impure nitroglycerine.

Action of Alkaline Sulphides. The reaction is very energetic. The mixture soon assumes a deep red brown colour, the temperature rises, and the action of the sulphide is completed with a sudden and abundant precipitate of sulphur in every part of the mixture simultaneously. No gas is given off, and, contrary to expectation, after being boiled with the sulphide for half-an-hour, filtered to remove sulphur, treated with lead acetate, and again filtered to remove sulphuretted hydrogen, it yielded evidence of the presence of nitrous acid to the extent of little less than one half the proportion yielded by purely alkaline decomposition. It would appear, therefore, that the whole of the nitrous anhydride set free is not acted upon by the sulphuretted hydrogen. For we may assume that the alkaline sulphide itself takes an initial step in the decomposition. The sulphuretted hydrogen plays a subsidiary part and merely acts on the nascent products of decomposition. It is difficult to explain, however, why the whole of the nascent nitrous anhydride should not thus be decomposed by sulphuretted hydrogen. It may be suggested that the nascent nitrous acid combines in part, with the alkali, and, once so united, it is not capable of being acted on by sulphuretted hydrogen. But sulphuretted hydrogen does not play an altogether passive part in the actual decomposition of nitroglycerine itself, for when an aqueous solution of an alkaline sulphide is poured over pure undissolved nitroglycerine, and the mixture vigourously shaken, the solution becomes reddish and when the temperature rises sufficiently, the whole of the nitroglycerine is suddenly decomposed with copious formation of sulphur. In fact the nitroglycerine seems to be converted into a mass of sulphur. When caustic potash alone acts on nitroglycerine, in such circumstances, the decomposition proceeds very slowly. The presence of sulphuretted hydrogen very greatly promotes the decomposition of nitroglycerine, but in what particular manner has not been definitely ascertained.

Action of Water. A saturated aqueous solution of nitroglycerine was heated for 3 hours. There was no sign of decomposition, and no trace of nitrous acid, except when sulphuric acid was added, when a distinct blue colouration was obtained. The nitrous acid had therefore combined with some other decomposition product of nitroglycerine, and was found to amount to 1·7 per cent. of the nitroglycerine employed. Potash treatment gave 8·88 per cent. of nitrous acid. Hence 73·48 per cent. of the nitroglycerine had been decomposed by heating with water for 3 hours. A portion of this, may, however, have been lost by simple evaporation, though this was to a certain extent avoided by heating in a long-necked flask.

Action of Alcohol. A 1 per cent. alcoholic solution of nitroglycerine was heated for 1 hour, the alcohol being renewed as it evaporated. There was no change in colour, and no nitrous acid could be detected, even when sulphuric acid was added with the usual reagents. A portion of the fluid was decomposed with potash and the nitrous anhydride was found to amount to 33·45 per cent., proving that the nitroglycerine had not been decomposed by heating with alcohol. From this it is evident that alcohol, when used as a menstruum in ascertaining the action of other substances on nitroglycerine, does not of itself aid in the decomposition.

Solubility of Nitroglycerine. The following figures were ascertained for the solubility of 1 gram of nitroglycerine in the respective solvents mentioned. Water (800 c.c.); absolute alcohol (4 c.c.); rectified spirit (10 c.c.); methyl alcohol (1 c.c.); methylated spirit (4 c.c.); amyl alcohol (18 c.c.); ether, chloroform, carbolic acid and glacial acetic acid (all proportions); benzol (1 c.c.); carbon disulphide (120 c.c.).

Yield of Nitroglycerine. The yield of nitroglycerine was determined, as obtained under very varying conditions of acid mixture and the proportion of glycerine employed. Price's pure glycerine dried for 6 hours at 120°C. was used. The acids used were each of two strengths. Nitric acid of 1·422 sp. gr. and 1·494 sp. gr. Sulphuric acid of 1·844 sp. gr., and fuming sulphuric acid of 1·984 sp. gr. The mixed acids were always placed in salt and ice and cooled below 0°C. In certain cases where urea was also used it was added to the nitric acid previous to mixing it with sulphuric acid. The temperature of nitration was never allowed to rise above 10°C. This mixture was poured into a large and measured mixture of cold water. The precipitated nitroglycerine was collected, and in this slightly impure state was dried at 70°C. The weight of dried nitroglycerine, increased by the proportion known to be lost by solution in the water into which it had been thrown (calculated from a solubility of 1 in 800), gave the total yield of nitroglycerine. The following table gives the results of these experiments.

GRAMS.					Yield of N.G. %
Glyc	Nitric Acid.		Sulp. Acid.		
	1·422	1·494	1·844	1·984	
12.4	—	30	75	—	—
6.1	urea 1 grm.	15	30	—	—
10.4	30	urea 1 grm.	30	—	16.3
8.8	25	,, 1.5 ,,	50	—	107.8
10.2	30	—	60	—	163.8
10.8	30	—	90	—	175.6
10.6	30	—	90	—	180.2
9.4	—	20	20	20	202.7
10.2	—	20	10	30	184.3
9.6	30	—	30	—	30.1
10.3	—	30	90	—	227.1
10.5	—	30	30	30	233.3
10.25	—	30	20	40	231.7
10.0	—	30	60	—	234.1

(1) *Trans. Roy. Soc. Edin.* (1887), 69.
(2) *Tijdschrift voor wetensch pharm* (1854).

Protection of Buildings from Lightning.—Mr. Alfred Hands in a lecture delivered last month before the Society of Architects stated that from statistics he had compiled lofty buildings account for only about eight per cent. of the instances of damage caused by lightning. Working from this basis he went on to point out that the smaller and less prominent buildings needed carefully protecting, and he dealt with some of the more necessary precautions which need to be observed.

ROUND THE TRADE.

The London Sporting Park have recently opened premises in New Bond Street.

Messrs. Debenham, Storr & Sons will hold their first monthly sale of guns and other sporting effects for this season on Friday the 8th inst. at their auction rooms, 23, King Street, Covent Garden.

It was at the meeting of the gun section of the Chamber of Commerce at the beginning of last month that Mr. Peddie moved his famous resolution calling the attention of the National Rifle Association to the very serious harm which they are doing to the trade by converting obsolete Martini rifles to ·22 bores.

Mr. A. H. Gale, with characteristic energy, has been occupying his spare time lately with the acquisition and fitting up of a large extent of ground, adjoining the site of the old Middlesex Gun Club, to be devoted to clay bird shooting in its various forms. An inaugural meeting will take place on Saturday the 2nd inst.

The overlapping of work in the Patent Office at times produces some comic situations. The latest example is provided by the *Official Journal* of the 8th ult. which occupies the best part of two pages with a list of amendments to the Robertson single trigger patent, the demise of which was announced about a month earlier. Past experience shows that patents which are legally dead can be legally revived.

The directors of the British South African Explosives Co., Ld., have recommended a dividend for the year ended October 31 last of five per cent. free of income tax. The previous year's distribution was 6½ per cent. The net profit is, however, £94,335 against £88,774 in the previous year. The directors, however, regard the diminution as a necessary act of prudence, in view of the severe competition promised in the future. Prices in fact seem likely to rule so low as to place in jeopardy the possibility of maintaining the factory.

Although no hard and fast agreement has been arrived at concerning the observing of a minimum scale of prices for the leading brands of sporting cartridge, the subject has been earnestly discussed and many points of difficulty have been satisfactorily solved. The manufacturer has the strongest interest in seeing that his goods are not sold at too cheap a price. The loss of profit to the retailer is of but little benefit to the private purchaser, yet it creates an ever present inducement to make experiments with inferior goods from some outside source. With advertised brands of goods of established excellence it is positively necessary that they should be sold on a price maintained basis. The numerous examples of the successful working of this arrangement afford a constant object lesson of the advantage that would accrue from its extension to specialised articles where the market conditions are suitable. There are many who believe that the sporting cartridge trade could be satisfactorily regulated on such lines, provided the prices were not fixed on too generous a scale. Brass covered cartridges should certainly be unobtainable anywhere at less than 12s. or 12s. 6d. per hundred retail. Waterproof cartridges should likewise fetch within a shilling of brass. The drop to gastight should be another sixpence, making them 10s. 6d. or 11s. as the case might be. Nitro quality at 8s. 6d. or 9s. should meet the needs of those who want a good cheap cartridge, and 7s. 6d. should be rock-bottom rates for rabbit ammunition. This suggested scale of prices may provide inspiration where it is needed by those preparing next season's lists. To sell cheaper seems like cutting unfairly into the philanthropy business; to sell dearer would be necessary where credit is given. In other words the recommended prices aim at defining the happy mean.

Mr. A. H. Watson and his salesman, George Kelly, were summoned last month for selling, contrary to the provisions of the Pistols Act, a revolver to a woman who subsequently shot herself with it. Although the selling was carried out by the assistant, one of the proprietors of the business, Watson Brothers of Old Bond Street, was joined in the summons as responsible for the actions of his agent. The magistrate inflicted a fine of £3 and 2s. costs in each instance.

Messrs. Charles Osborne & Sons have written informing us that they are placing on the market an all English made single barrel shot gun, a catalogue of which shows it to be of the drop down type which has been imported in such large quantities from America during recent years. A request to be favoured with a view of the new gun having met with no response, we are unable to endorse from our own experience the many points of excellence claimed for this production.

The sum mentioned in a recent issue as likely to be required for the equipment of the Kynoch factory in South Africa, viz. £100,000, was by various persons supposed to have been a misprint, the assumed cost being a round million. The *Financier and Bullionist*, however, confirms the idea that a modest scale of working is contemplated at the start, a recent issue placing the amount to be expended on building and plant at £200,000. The Modderfontein factory, according to the balance sheet of the Company, cost £896,932, but this sum has since been diminished by writing off sums annually to £462,000.

Messrs. Joseph Lang & Son of 102 New Bond Street have appointed agents for the sale of their guns and rifles at 8 Avenue de l'Opéra, Paris, and in proof of their enterprise they forward a specimen of their catalogue fully translated into French. A further edition has been printed for Italy, chief agents having been appointed at 6 via Cavour, Florence, with sub-agencies at Milan, Genoa, Rome and Naples. As showing how thorough is the desire to cater for these important markets in a right spirit it should be mentioned that the models of gun depicted have been expressly designed with a view to fitting the styles favoured in the two countries named.

The clay bird shooting competitions in connection with the Olympic Games of London, 1908, will, as already announced, be held at the grounds of the Uxendon Shooting School Club, near Wembley Park, on July 8th, 9th, 10th and 11th next. A limited number of exhibition tents to be erected on the grounds, ready for occupation during the meeting, can be let to gunmakers, etc., for the purpose of exhibition, trade and sale. The sole rights of sale of ammunition and shooting accessories on the grounds during the meeting will be vested in the occupants of these tents. Details of tents and positions, conditions of letting, and prices for spaces, should applicants prefer to erect their own tents, may be obtained on application to the Secretary, Clay Bird Shooting Association, 68 Aldersgate Street, London, E.C.

The side uses of explosives are especially interesting in a country like the United States where so much virgin territory still awaits reclaiming. The breaking up of frozen piles of ore in winter, clearing ice gorges, starting log jams and roll-ways, breaking boulders, clearing land of stumps and trees, blowing holes for transplanting trees—these are a few of the outside uses of explosives. To be satisfactorily accomplished each needs doing in a special way, and the Dupont Company of the United States have sent us three most interesting pamphlets giving instructions on the use of blasting agents with a wealth of illustrations which a text book could not emulate and an amount of first hand practical information only possessed by a Company in a position to gather its facts from every centre. The literary standard observed is very high.

THE STANDARDIZATION OF ·22 CARTRIDGES.

THE entire movement in favour of national rifle shooting is taking the direction of developing clubs whose sole business is to shoot with ·22 rifles. Greener designed the ·310 cartridge, thinking that by so doing he was giving the clubs what they wanted. Major Gaudet, now Col. Gaudet gave them a reloaded service cartridge. Trask provided the most successful of the adapters, and authorities with no rank as experts, Sir Conan Doyle for example, recommended the long Morris tube cartridge. All these have gone by the board, and the ·22 long rifle cartridge remains. The U.M.C. Company for a long time held the field with their black ammunition. The premier position was wrested from them by the King's Norton Company's smokeless cartridge, and this and the "R" brand have run a close race ever since. The essential characteristic of these two cartridges is that they give high ballistics, and in so doing ensure the highest grade of accuracy. The price paid for these advantages is that which follows from high pressure, viz., lessened ease of extraction and increased liability for the cases to burst. The tendency towards trouble exists with all rifles, but some designs are better adapted than others to resist the effects of high pressure. The shooter asks for a cartridge which is specialized for accuracy before all other things. He does not worry if the fired cases are hard to extract, nor does he much care if the rims occasionally burst and let a little gas escape into the breech, always provided that accuracy is not affected. A slight escape seldom makes a shot strike low. It may even serve to equalise the pressure by acting as a safety valve, but a bad burst lets out enough gas to cause the shot to strike low. The maker of cartridge cases is between the devil and the deep sea, and the rifle maker is equally badly situated. Neither can admit that his goods are not universally adaptable. The cartridge maker must see that the metal of his cases is soft enough to flatten under a weak striker blow, and he must at the same time guard against the risk of bursts to which a sensitive cartridge case is always due. The cap composition must likewise be sensitive enough to go off with the striker blow caused by a mainspring exerting a force of less than 5lbs. when under full compression, and yet it must not show unduly increased activity when the cartridge rim receives the sledge hammer blow of a strong spring acting on a long striker.

Neither party can legislate for all the eccentricities of the opposite side. Ignition is affected in the rifle by the strength and travel of the mainspring, the weight of the striker and of the attached parts which move with it, the shape, area and location of the striker point, the degree of contact between the breech face and base of cartridge and to some extent by the support the cartridge receives from contact with the walls of the chamber. These items are subject to needless variations in the different rifles upon the market. Some are hopelessly bad from inherent defects of design which cannot be altered without remodelling the whole weapon, others are wrong because of ignorance, or because well understood defects creep into the manufactured output. No one can legislate for perfection. The shooter is steadily eliminating the bad rifles by refusing to use them, and each manufacturer is becoming more and more accustomed to the new duties which have come along, but as soon as one trouble is overcome another is created by the shooter's constant demand for an ever enhanced standard of accuracy. Those who seek to evade the difficulty by lowering the efficiency of the cartridge will soon fall out of the running. The tendency must be towards levelling up, and those who would adopt the opposite process will find that they are on the wrong track. The ·22 cartridge must have a high velocity to give the requisite accuracy and flatness of trajectory. The rifle to shoot it must support the cartridge so as to prevent an escape of gas, and at the same time be efficient both in extraction and ejection.

No weapon fulfils all the requisite functions, but improvements are daily being made, and all of them tend in the direction of lessening the demands made on the strength of the delicate copper case. Alterations of design will tend towards producing greater uniformity in the character of the striker blow than at present exists. The blow in the case of a shot gun is characterised by immense velocity and a very small weight of the moving parts with a definite stop to take up surplus strength. It is not as well understood in the case of rifles as it should be that the weight of the firing pin cannot be indefinitely increased without damping down the action of the blow and at the same time unduly prolonging the delay between pulling the trigger and striking the cap. The use of a powerful spring to correct the evil of a heavy firing pin introduces another difficulty equally serious. The surplus energy over and above that necessary to dent the rim of the case must be caught somewhere, and unless the surfaces acting as a stop have a very large area they will gradually give way, the striker will push its way further and further beyond the face of the breech, and troubles which are laid at the door of the cartridge maker will begin. It is open to anyone designing a rifle *de novo* to put into practice some of the theory which previous troubles have impressed on the mind. Heroic legislation would be entirely out of place for most of the points which have to be decided. Evolution alone will show how details must be decided to give the greatest balance of advantage. Turning once more to the sister science of the shot gun it is apparent at once that nothing but good would follow from laying down by mutual agreement a proper series of chamber diameters. The sizes would need to cover both maximum, minimum, and what few people understand the mean size as well. This is the size to be observed as closely as possible by the manufacturer, and it is not necessarily midway between the extremes. Length of chamber, diameter of barrel and the general specification of rifling and lead are all questions which are best left alone for the present, since no one is agreed what is best. The chamber is the chief point of contract with the ammunition maker, and its dimensions should certainly be authoritatively standardized.

THE BLENDING OF SHOT.

MANY causes have contributed of late years to make the testing of guns for pattern a much more scientific process that it was in times gone by. The needs of sportsmen are every year becoming better defined; full-choke has long ceased to constitute the only kind of choke put into a gun, and the slight muzzle reduction which is spoken of as improved cylinder requires skill on the part of the barrel borer and special care in testing at the target to ensure the exact result aimed at. In a recent lecture to young gunmakers great stress was laid upon the importance of setting aside for pattern testing experiments a supply of No. 6 shot running exactly true to the nominal size. It was assumed when giving this advice that the gunmaker would have passing through his hands in the ordinary course of trade a sufficient quantity of shot to enable him to select here and there a bag absolutely true in count. The exact routine to be adopted in making the necessary selection was not specified, partly because considerations of space made it impossible to dwell too long on any single section of the subject then under consideration.

Some measurements which were made with a recent delivery of four bags of shot will now provide the text for a short description of the actual processes involved. It should be mentioned beforehand that the shot was ordered to as nearly true to size as possible, as it was intended for use in experimental work. This no doubt accounts for the fact that two out of the four bags ordered were exactly true to size, the other two needing just sufficient adjustment to exemplify the blending process which was adopted. The bags which were found to be exactly correct were numbered 3 and 4 respectively, this happening to be the order in which they were examined. A shot trowel was set to count 270 pellets, this being the number per ounce for No. 6 size. The entire bag of shot to be dealt with was turned into an ordinary cartridge box, and the contents were stirred sufficiently to make quite sure of uniformity throughout the mass. Such a precaution may appear far fetched, but it was based upon the known tendency of granulated materials to sort themselves out into sizes when the receptacle is subjected to vibration. The skilled cartridge loader certainly takes the precaution, before opening a tin of powder, to give it a thorough shaking, for he knows that by this means alone can uniformity of loads be preserved.

The process of checking the weight of the 270 counted pellets consisted in placing them in one pan of a chemical balance, using on the opposite side an ounce weight of proved accuracy. Something less sensitive than a chemical balance would doubtless have been good enough for the purpose, but no lack of precaution should be sanctioned in the case of avoirdupois weights, for it must be remembered that one occasionally comes across very faulty specimens. Instead of taking the weight of the 270 pellets, the process was simplified by adding or removing pellets until a balance was established, the number of pellets to the ounce being thus duly recorded. This measurement was carried out several times with each bag of shot to strike an average and at the same time give some kind of clue to the degree of regularity. The results obtained with the two bags true to size were as follows :—

Bag 3	270	Bag 4	269
	270		272
	269		269
	270		268
	269		269
Av.	269·6	Av.	269·4

Both sets of results are exceedingly interesting. The first shows how extraordinarily regularly a single sample of shot may weigh out time after time. The results with Bag 4 show a greater margin of variation, and this better indicates the differences which must be expected in a sample of shot which upon visual examination shows substantial evenness between pellet and pellet. The exact amount of permissible variation may be roughly placed at one per cent., say three pellets variation up or down from the average recorded. This would admit samples showing variations from 267 to 273, inclusive, but with well made shot it would only occasionally happen that the limits were reached. Bags No. 1 and 2 were tested with the following results :—

Bag 1	272	Bag 2	265
	277		264
	272		265
	272		267
	273		264
Av.	273·2	Av.	265·0

Bag No. 1, apart from the curious freak shown in the second weighing, is obviously a trifle above the 270 average, and it could well be passed as it stands except that the adjoining results with Bag No. 2 introduce a decided temptation to hit off a 270 average by making a judicious blend. One would avoid if possible using for pattern testing purposes a sample of shot running 265 to the ounce. If such pellets are counted into the cartridge, as they should be for all pattern testing work, there would be an over-charge in weight of ten grains, which compares with 27·3 grains, the equivalent of the sixteenth of an ounce. It is obviously better to blend samples having opposite errors in order to arrive at a correct average size rather than accept so large an error as five pellets per ounce. This does not imply of course that an equal mixture of 5 and 6 shot would make a satisfactory sample of 5½ shot, because unevenness of size between pellet and pellet is bad gunnery and should not be countenanced even where it cannot make much difference. The following table shows the series of blendings which were adopted to ascertain the proportions in which Bags 1 and 2 should be blended :—

Half and Half blend.	1 part Bag 2 1½ parts Bag 1.	1 part Bag 2 2 parts Bag 1	Same blend. Remeasured.
268	269	270	268
268	269	272	272
270	270	271	271
267	269	273	270
268	269	272	270
Av. 268·2	Av. 269·2	Av. 271·6	Av. 270·2

It will be seen that a practically perfect blend was eventually obtained by mixing the whole of Bag 1 with half of Bag 2, the other half of Bag 2 being set aside for ordinary commercial loading. This shows how by taking a little trouble seven-eighths of the total delivery of shot was made exactly true to size. With shot true to this standard of accuracy a single stab of the trowel produces not only a counted charge of shot, but what is even more important a charge which may also be regarded as weighed. Considering that counting occupies about a tenth of the time which must be devoted to the weighing process it is certainly worth while taking a little trouble to ensure that the simple and mechanical process of counting shall include the more expert and tedious operation of weighing.

THE AIR RESISTANCE OF PROJECTILES.

BY F. W. JONES.

THE resistance encountered by a projectile moving through air has not yet received its mathematical explanation. The actual determination of the total air resistance at different velocities has improved with the improvement in taking time measurements, but the factors of this resistance are hardly any better appreciated now than in the time of Hutton about 1790. At this early date Hutton writes: "Thus then we see that the resistance "against the ball is two-fold, the one arising from percussion "of the ball striking and displacing the particles of air "in its path, and is proportional to the square of the "velocity, and the other" (the partial vacuum at the rear) "from the weight of the atmosphere, increasing with "the velocity, and arriving at its maximum when that "is equal to the velocity of air passing into a vacuum." Since Hutton's time bullets in flight have been photographed. These show an air wave in front of the bullet and, when the bullet's velocity exceeds about 1,000 f.s. there is evidence of a wave and a partial vacuum at the rear of the bullet.

The subject of air resistance was treated by Mr. A. Mallock in the Proceedings of the Royal Society, June 1907. Mallock recognizes three factors of the total resistance of a projectile, viz., (1) That due to the nose forcing its way through the air and producing the front or bow-wave. (2) That due to the hinder part being dragged back by suction owing to the formation of a partial vacuum in the rear, this vacuum reaching its maximum and becoming equal to the pressure of an atmosphere for velocities exceeding 2,400 f.s., the velocity at which air rushes into a vacuum, and (3) The energy lost in producing the rear or stern-wave. The factors (1) and (2) are unquestionable, but differences of opinion may exist as regards both the origin and nature of the stern-wave. Mallock's expression for it is quite empirical, and to make the agreement between calculation and observation, for flat and ogival nose projectiles, the stern-wave coefficient is in one case about five times greater than in the other. Thus the resistance due to the stern-wave, per square inch cross section at the velocity of 3.000 f.s., is 34lbs. for a flat nose and only 6lbs. for an ogival nose. Under these circumstances it appears better to treat the two factors at the base together and divide the total air resistance into (1) that due to the projectile's nose, and (2) the resistance not due to the nose.

Now it can be shown that if a moving body presents a plane surface of area S, to a fluid at rest, and which is at right angles to the direction of motion, then the pressure on this plane surface will be

$$c \frac{d}{2g} S v^2 = p_o S \qquad (1)$$

where d the weight of unit volume of the fluid and g gravity

v = the velocity of the moving body

c = a constant

p_o = the pressure on unit area

When the surface is oblique to the direction of motion, the pressure is obviously less than above. Fluid pressure on any surface with which it is in contact is perpendicular to the surface. If the angle which the perpendicular to the plane makes with the direction of motion is a, and p^1 is the pressure per unit area on this oblique plane, then by the resolution of forces, the pressure in the direction of motion is p^1 S Cos a and at right angles p^1 S Sin a.

*Duchemin found by experiment that the perpendicular pressure on a plane surface set at various angles to moving air is

$$\frac{2 p_o S}{1 + \text{Sec}^2 a}$$

where p_o is the pressure per unit area when the angle is nil. Taking this practical value of p^1, then a moving oblique surface has a pressure in the direction of movement

$$p_o S \frac{2 \text{ Cos } a}{1 + \text{Sec}^2 a} \qquad (2)$$

and a lateral pressure at right angles to the movement, but this may be neglected in the case of projectiles, when friction is ignored, because this pressure comes from all sides and thus mutually balances.

The heads of all service projectiles are symmetrical about an axis and therefore solids of revolution. This renders it possible by integration of the elements of pressure on each small area of the nose, to calculate the whole nose pressure retarding the projectiles movement and thus compare relative pressures of different shapes. The particulars of these calculations are to be found in *Ingall's Exterior Ballistics*. Ingall's general expression for air resistance due to nose takes the form,

$$p_o \pi R^2 F(n) \text{ or } c \frac{d}{2g} v^2 \pi R^2 F(n) \qquad (3)$$

where R = the radius of the projectiles diameter and

F(n) = a function of form of the nose.

It should be noted that the terms $S \frac{2 \text{ Cos } a}{1 + \text{Sec}^2 a}$ in (2) is replaced by $\pi R^2 F(n)$ in (3) viz., the sectional area of the projectile and a function of form of the nose. Now when $F(n) = 1$ the nose is flat, consequently this function indicates the relative resistance of different shapes of nose. Let NR equal the length of nose of a conical or ellipsoidal head, also let it equal the radius of the generating circle of an ogival head, then the values of the function of form for these three heads will be as set out in Table I.

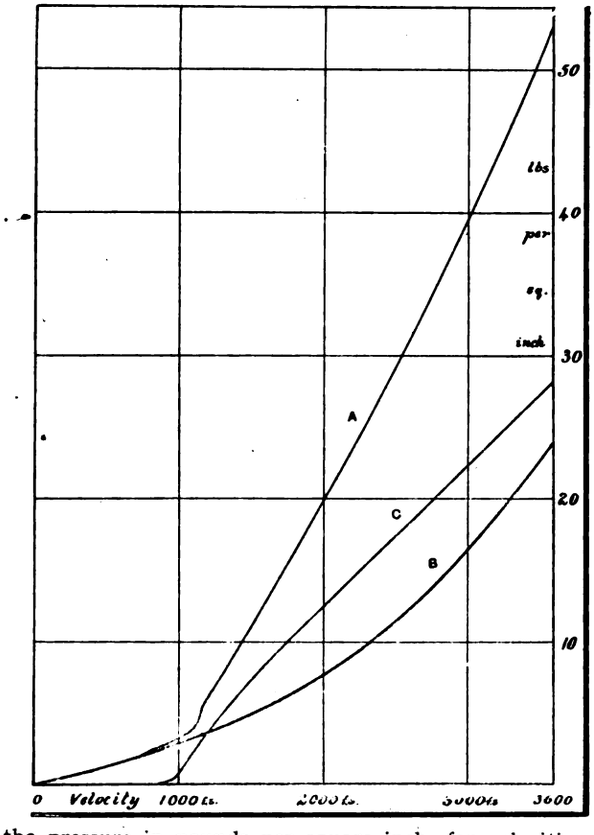
TABLE I.

N	The Value of F (n) the function of Form.		
	Ogival Head.	Conical Head.	Ellipsoidal Head
0	1·000	1·000	1·000
1	·614	·666	·614
2	·419	·333	·386
3	·318	·181	·266
4	·215	·111	·196
5	·257	·074	·146
10	·118	·019	·061
20	·048	·005	·018

* See *Encyclopædia Britannica*, Hydro-Mechanics, Vol. 12, pages 515 to 518.

The expression (3), for pressure per unit area and a given shape of nose, can be written as follows :—Resistance due to nose = Constant × density of air × ½ velocity squared. Although this general form is independent of hypothesis, the value of the constant, viz., c F (*n*) cannot be fixed by theory. Fortunately estimations of the total air resistance settles the maximum value. If the exact value of the constant for one form of nose can be obtained then the values of the other forms will be given by Table 1.

The total air resistance of a projectile with an ogival head of 1½ diameters, (*i.e.* $n = 3$) has been determined with great accuracy. The curve **A** herewith represents



the pressure in pounds per square inch for velocities up to 3,600 f.s. on a projectile having an ogival head of 1½ diameters. It has been drawn from the equations given by Ingall's. The equation for velocities of 1 f.s. up to 790 f.s. in pounds per sq. inch is pressure = $0{\cdot}00000185\ v^2$. Now it is clearly obvious that the resistance due to the nose cannot be greater than the total resistance. For velocities under 800 f.s. the vacuum and stern-wave at the rear are absent and it is therefore probable that the total resistance is not materially greater than that due to the nose alone. This assumption will be made here, the total resistance below 790 f.s. being taken as due to the nose only. Thus equating Ingall's expression for total air resistance below 790 f.s. to that of equation (3) and giving F (*n*) its value 0·318, the term c then becomes 0·7 and equation (3) may be written

$$F = 0{\cdot}7 \times 0{\cdot}318 \times \frac{d}{2g} v^2 \qquad (4($$

Where F is the resistance in pounds per square inch of a 1½ diameter ogival headed projectile. By means of this expression (4) the curve **B** has been drawn and the curve **C**. of the same figure represents the difference between curves **A** and **B** or the resistance not due to the form of the nose. Amongst the resistances not due to the form of the nose there are (1) the partial vacuum at the base of the projectile, (2) the skin friction between the air and the projectile, and (3) the effects of imperfect steadiness of flight. The sum of these resistances is greater than that due to the nose for the more usual form of bullet, and much greater than for the Spitzer form of nose, as is evident from the diagram. Now as the incidence of this sum is at the rear of the projectile may it not be that, for bullets with a small nose resistance, there is called into play the same forces for steady flight as are present in a moving arrow, as well as those due to the rotation of the bullet.

It is now possible to enquire and ascertain whether the total resistance to projectiles of various forms of nose can be calculated. This enquiry will be restricted to small arm bullets which may be taken as having a constant coefficient of steadiness. With this restriction the coefficient of reduction will be directly proportional to the total air resistance. Let the value of the coefficient of reduction for a bullet with an ogival head of 1½ diameters be taken at 0·80, also make the value of F (*n*) for this shape of nose equal to unity. Then the details in Table II. follow from the curves given. An example will be given later.

TABLE II.

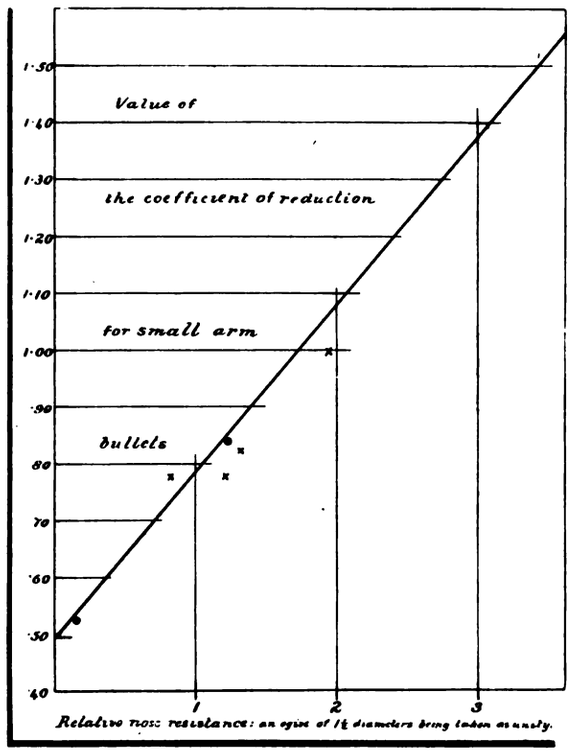
Nose.	F (n)	Calculated Coefficient of Reduction.	Relative resistance from the Text-Book of Small-arms.
Flat	3·15	1·43	1·53
Hemispherical ..	1·93	1·06	1·00
Ogival of one diameter	1·32	0·88	0·83
,, two ,,	0·68	0·74	0·78
,, ten ,,	0·15	0·54	—
Hemispheroidal ..	1·21	0·85	0·78

These values are set out graphically overleaf. The calculated coefficients of reduction lie on a straight line The values from the Text-Book are represented by crosses. The two dots are experimental values found on shooting .303 bullets one having a head of 10 diameters ogive, and the other a hemispheroidal head with the axes in the ratio of one to two. These experimental results agree absolutely with the calculated values and the relative figures from the Text-Book lie close to them. As an example of the calculation take the relation of heads with ogives of 1½ and 10 diameters respectively.

M. V. f.s.	Nose Resistance. 1½ dia. lbs.	Nose Resistance. 10 dia. lbs.	Total Resistance. 1½ dia. lbs.	Total Resistance. 10 dia. lbs.	Ratio of Total Resistance. %
2500	11·5	1·7	29·4	19·6	66·7
2200	9·0	1·4	23·8	16·2	68·1
2000	7·4	1·1	20·1	13·8	68·6
1800	6·0	0·9	16·5	11·4	69·1
1600	4·7	0·7	13·0	9·0	69·2
1400	3·5	0·5	9·8	6·8	69·4
1200	2·6	0·4	6·4	4·2	65·6

The average ratio of the total resistance is 68·1 % and this multiplied by 0·80 equals 0·54, the value of the coefficient of reduction for an ogival nose of 10 diameters. This is the form of nose adopted for the Spitzer, used at last Bisley.

It will now be obvious that calculation goes a long way to determine the total resistance of a bullet with a novel form of nose. It also may be pointed out that the nature of this calculation was nearly as well known in Hutton's day (1790) as at present. This being so it is not easy to understand why the comparatively low air resistance of a Spitzer nose had to be discovered by experiment and was for so long a time doubted by the military world. The explanation may be found in the two circumstances, first



that the resistance encountered by a projectile in passing through the air has been dealt with by authorities as a whole instead of being split up into its factors, and secondly the statement, so often repeated in text-books, that the point of a projectile has less effect on resistance than the surface joining the head and the body of the projectile. If this latter were true the .303 service bullet should have nearly the same value for the coefficient of reduction as the Spitzer. The next step in the reduction of the air resistance of a bullet must follow from attention to the force at work at the rear of a bullet in flight. This, however, is not easy, and many practical results will be necessary before consistent theory is possible. A final table to show the resistance in terms of the length of nose will be useful, because for many reasons this length cannot exceed a certain limit, therefore, the least resistance for a determined length of nose is a practical piece of information.

Length of Nose in Diameters of Bullet.	Value of the Coefficient of Reduction.		
	Ogival Nose.	Conical Nose.	Ellipsoidal Nose.
0·5	1·07	1·11	1·07
1·0	0·84	0·81	0·86
1·5	0·70	0·67	0·74
2·0	0·63	0·60	0·68
2·5	0·58	0·56	0·63

APPLICATIONS FOR PATENTS.

MARCH 23—APRIL 18, 1908.

6,544. Ordnance Firing Gear. A. T. Dawson and G. T. Buckham.
6,614. Wind-Gauge Slides. C. W. Miles and L. G. Procter.
6,625. Rifle Sight Attachment. H. Ommundsen and D. M. Fraser.
6,654. Ordnance Firing Gear. A. T. Dawson and G. T. Buckham.
6,680. Guns. Sir H. S. Maxim.
6,691. Disappearing Targets. F. J. T. Bott and F. W. Nicholas.
6,843. Automatic Small Arms. H. W. Holland and T. Woodward.
6,845.* Firearms. H. P. Maxim.
6,942. Armour-piercing Projectiles. J. R. Hoyle and H. B. Strange.
6,944. Projectiles. R. A. Hadfield and A. G. M. Jack.
7,184.* Removing Foul Gases from Gunbarrels. Fried Krupp.
7,191. Range Finder. H. Macaulay.
7,228.* Firearms. L. J. Graham and H. R. Latham.
7,247. Moveable Targets. A. Inskip.
7,262. Telescopic Apparatus. J. H. C. Grant.
7,266. Small Arms Backsights. C. W. Miles.
7,280. Sights. A. Tunstall and W. F. Brant.
7,340. Air Gun Target. J. F. Bird and W. Bernard.
7,426. Cartridge Carrier. H. J. Blanch.
7,486. Ordnance. G. J. Stevens.
7,570.* Ordnance Sighting Gear. Fried Krupp.
7,609.* Guns. W. T. S. Corrigall.
7,624. Recoil Loaded Pistols. J. E. Kulhanek.
7,809.* Percussion Fuses for Projectiles. E. Schneider.
7,820. Cartridge Carriers. F. R. Batchelder.
7,858. Aperture Rifle Sight. P. M. Payne.
7,881.* Ejector Mechanism of Drop Down Guns. C. Ryland.
7,889. Sear Check for Preventing Discharge. J. Leedale.
7,921.* Explosives. A. J. Boult.
7,938.* Attaching Gun Stocks. J. F. Beck, Senr.
7,995. Rifles. T. R. R. Ashton.
8,078. Training Gear of Gun Mountings. Armstrong Whitworth & Co., and F. G. D. Johnston.
8,105. Armour piercing Projectiles. R. A. Hadfield and A. G. M. Jack.
8,260.* Percussion Fuses. Fried Krupp, A.-G.
8,325. Sight Testing Instrument. C. A. Fountaine.
8,346. Apparatus for Gun Fire Control. H. J. Creffield.
8,352. Drop-down Small Arms. J. Rogers.
8,358. Gunpowder. G. Trench and R. L. Smart.
8,432. Target. W. H. Hardwick.
8,435. Gun Aiming Device. H. W. L., J. J., and W. J. Steward.
8,516. Expanding Bullets. G. Brewer.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

MARCH 26—APRIL 16, 1908.

COMPILED BY HENRY TARRANT.

2,558 (1907). **Ordnance Laying Apparatus.** Lieut. A. T. Dawson and G. T. Buckham, London. The ranging and elevating screws are arranged lengthwise of the trail and coaxially as usual and the actuation of one imparts motion to gun cradle and sight bar and of the other to the cradle alone. The means whereby the motion is transmitted to cradle and sight bar and the traversing frame are improved. Accepted Feb. 29, 1908.

4,890 (1907). **Turret Gun Mountings.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. In turret

mountings for three guns, apparatus is introduced whereby the guns may be elevated separately or two or three together. In the last case the three guns may be manipulated from one sighting and controlling station by means of motor apparatus set out in patent No. 9,490 1903. The guns may as an alternative be elevated by hand; means are provided for correcting differences in level and for compensating variations of muzzle velocity. Accepted Feb. 28, 1908.

5,132 (1907). **Teaching Ordnance Laying.** Col. M. Calderara, Italy. A method of teaching laying and firing of ordnance is provided by fixing a rifle barrel to the piece capable of rocking through an arc concentric with the arc of movement of the sighting apparatus. The supplementary target is moved about to resemble the actual movements of a real naval target. Accepted March 2, 1908.

5,637 (1907). **Machine Gun Mechanism.** Lieut. A. T. Dawson, and G. T. Buckham, London. Certain novel features are described of a reciprocating lock mechanism for guns of the Maxim type. Simplicity of construction and lightness are aimed at. The gun may be provided with any ordinary shoulder piece or a handle block. Accepted March 7, 1908.

5,716 (1907). **Ordnance Sighting Gear.** Lieut. A. T. Dawson, London and J. Horne, Barrow-in-Furness. The telescope of ordnance sighting apparatus is automatically given a greater or less elevation to compensate variations of muzzle velocity. The adjusting part of the apparatus carries a roller which works over a cam surface. Accepted March 5, 1908.

5,982 (1907). **Turret Ordnance Sighting Apparatus.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. The prismatic sighting tube which projects through a lateral opening in the turret is connected with apparatus whereby changes in muzzle velocity are automatically compensated. Accepted March 12, 1908.

6,485 (1907). **Breech Mechanism of Heavy Ordnance.** Lieut. A. T. Dawson, and G. T. Buckham, London. In breech mechanism which may be operated either by hand or by hydraulic or other power (as described in patent No. 13,108, 1906) the traverse shaft through which motion is imparted to the breech mechanism is provided with a clutch capable of engaging with either the hand or the power gear. Accepted March 18, 1908.

6,706 (1907). **Sighting Apparatus of Ordnance.** Lieut. L. J. Watson, Chatham Dockyard, and Lieut. A. E. Lester, Malta Dockyard. Means for indicating plainly the deflection of the axis of the sighting telescope consists of a scale which is magnified relatively to the actual deflection and which is actuated directly from the telescope carrier. Error due to lost motion between various parts is obviated. Accepted March 19, 1908.

6,818 (1907). **Shoulder Piece Ordnance.** Lieut. A. T. Dawson, and G. T. Buckham, London. The recoil is utilized to lock ordnance with a shoulder piece at the elevation at which it was fired so as to avoid any stress on the shoulder of the gunner. A device is employed not unlike that set out in patent No. 23,518, 1898, but it is modified to adapt it to the device described in patent No. 9,462a, 1904. Accepted March 21, 1908.

6,917 (1907). **Sighting Apparatus for Ordnance.** Lieut. A. T. Dawson, and G. T. Buckham, London. In patent No. 3,605, 1907 a calibrating device is described for angularly displacing the pointer relatively to the dial to correspond with corrections for changes in muzzle velocity. This device is now applied to sighting apparatus with a spirally grooved range dial having large readings and a radially travelling pointer. Accepted March 19, 1908.

6,949 (1907). **Machine Gun Feed Apparatus.** G. Perino, Italy. The cartridges for a machine gun are arranged in metallic trays placed one on top of another so that when one is emptied and ejected from the box the next above automatically drops into its place. Accepted March 12, 1908.

7,244 (1907). **The Sutherland Wind Gauge Peep Sight for Rifles.** H. Sefton-Jones, London. (Agent for *M. E. Sutherland, Canada*). (*See Selected Patents*).

7,517 (1907). **Ordnance Sighting Apparatus.** A. F. Petch and F. Duncan, London. To compensate alterations in muzzle velocity the worm, through which the range dial is rotated, may not only rotate but is also allowed to move when necessary in a direction parallel with its axis. Accepted March 5, 1908.

9,929 (1907). **Ordnance Control Apparatus.** A. F. Petch and F. Duncan, London. Elevating gear by which ordnance may be trained from a distant position without altering the line of sights with respect to the base of the mounting. Separate gear is provided by which gun and sight may be moved independently of the motor apparatus. Accepted March 19, 1907.

10,023 (1907). **Ejector for Small Arms with Telescopic Sights.** H. W. Lake, London (Agent for *The Winchester Repeating Arms Co., U.S.A.*) In rifles fitted with telescopic sights a guide is attached to the action body whereby the cartridge case, usually ejected in an upward direction, is deflected so that the telescope shall not be injured. Accepted March 19, 1908.

11,829 (1907). **Machine Gun Cartridge Belts.** Lieut. F. Ruszitozka, Upper Austria. In patent No. 1,088, 1907, a cartridge belt is described which has articulated sections or links held together so that when each had passed through the gun it is automatically disconnected from the rest of the belt. This invention is modified to adapt it for various guns with different mechanism. Accepted March 12, 1908.

12,961 (1907). **Ordnance Sighting Apparatus.** Sir W. G. Armstrong, Whitworth & Co., Ld., and J. Richardson, Newcastle-on-Tyne. The sighting apparatus described in patent No. 3,126, 1906, is provided with improved means whereby allowance to compensate changes in muzzle velocity may automatically be made. Accepted March 5, 1908.

13,721 (1907). **Sighting Apparatus for Ordnance.** A. F. Petch and F. Duncan, London. To compensate variations in muzzle velocity the range dial pointer is made in two parts, one capable of a radial movement across the dial, and the other capable of a rotary movement relatively to the first. Accepted March 19, 1908.

14,419 (1907). **Machine Gun Attachment.** Sergt. W. Boardman, Fermoy, Ireland. This attachment for machine guns is provided to allow of accurate sighting at night on a spot previously located. A vertical rod is arranged at the rear of the gun, its lower end sliding in a horizontal slotted plate. Accepted March 26, 1908.

15,200 (1907). **Range Finder.** H. D. Taylor, York. A method is here dealt with of improving the use of a deviating prism sliding to and fro between the object glass and the image of a single observing telescope, one half of whose object glass receives light from one end of the base and the other half from the other end of the base of a range finder. Accepted March 26, 1908.

17,639 (1907). **Cartridge Bandolier.** M. Pederson, Dursley. The bandolier is arranged to receive two rows of loaded cartridge clips lying base to base. The clips support each other and to remove them the belt has merely to be bent up longways at its middle. Accepted March 5, 1908.

17,678 (1907). **Automatic Arms with Toggle Joints.** H. Borchardt, Berlin. In fixed barrel automatic arms with toggle joint breech mechanism the toggle is unfolded by a new mechanical method. Through a special part pressure is applied beneath the rear member of the toggle. Accepted March 26, 1908.

19,565A (1907). **Nitro Explosives.** G. Schultz, Munich. A process is described of manufacturing safety explosives of nitro-compounds produced from solvent naphtha and more particularly from those produced by nitrating solvent naphtha in the manner set out in patent No. 19,565, 1907. An example of such a compound is given:—With 12 parts of solid nitro-compound obtained from solvent naphtha are mixed 88 parts of ammonium nitrate. It is claimed that this explosive is safe against blows, against heat to 200°C, and will not explode when a flame is applied. Accepted March 5, 1908.

21,278 (1907). **Pistol Safety Device.** R. Frommer, Budapest. A safety device is described which although designed for

all kinds of small-arms is particularly applicable to the pistol described in patent No. 20,362, 1901. Accepted March 5, 1908.

23,112 (1907). **Dividing Gelatinous Gunpowder into Grains.** G. H. Wadsworth, Lyndhurst. An improved machine is described for dividing gelatinous explosive into grains, by means of which the work is facilitated. Instead of knives working over the surface of a perforated plate through which the explosive is squeezed a circular body fitted with a number of knives is rotated very rapidly below, but not in functional contact with the die plate. The streams of explosives are divided by these knives. Accepted March 5, 1908.

23,713 (1907). **Small Arm Telescopic Sight Mountings.** W. E. Lake, London. (Agent for *Winchester Repeating Arms Co., U.S.A.*). Mountings for small-arm telescopic sights are designed to allow of elevation and particularly to prevent injury of the sight. Accepted March 5, 1908.

27,635 (1907). **Rifle Back Sight Slide.** A. Russell, Australia. (*See Selected Patents*).

1,813 (1908). **Cartridge Bandolier.** F. R. Batcheldar, U.S.A. To prevent wearing of a bandolier through the pointed bullet noses, extra plies are woven in with the main body of the fabric. Accepted March 26, 1908.

2,099 (1908). **Air Gun Targets.** A. E. Downing, West Bromwich. The combination metal "bell" target carrying a card target is modified so that the part struck by a pellet shall release an arm bearing a number corresponding to the value of the shot. Accepted March 26, 1908.

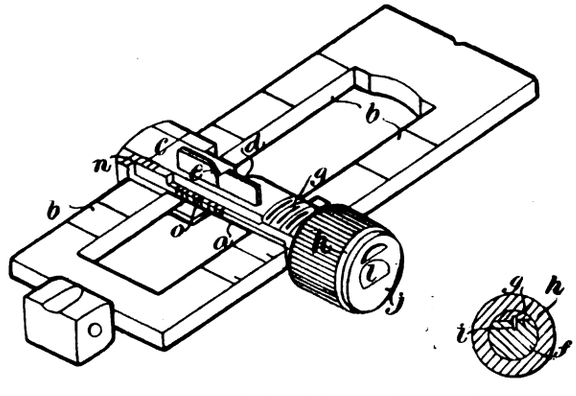
3,227 (1908). **Fuse Setting Machine.** Fried Krupp, A.G., Germany. To avoid inaccuracies in fuse setting an improvement is introduced into the mechanical setter by means of which the coupling between the adjustable part of the fuse and the setting body is automatically released precisely at the end of the setting operation. Accepted March 5, 1908.

SELECTED PATENTS.

RIFLE BACK SIGHT SLIDE.

27,635 (1907). A Russell, Australia. This windgauge slide for the back sights of rifles is designed so that it shall possess sufficient strength to guard it against injury from ordinary blows, screw adjustment being provided it is claimed without the introduction of a large number of more or less delicate parts.

The bar *a* slides on the leaf *b* in the usual manner. The left hand side of this bar is dovetailed to carry the slide *c* which is provided with the sighting notches *d* and *e* for use when the leaf is in the vertical and horizontal positions respectively. The right hand part of the bar *a* forms a boss *f* on the top of which is filed a flat as is shown clearly in the sectional illustration. On

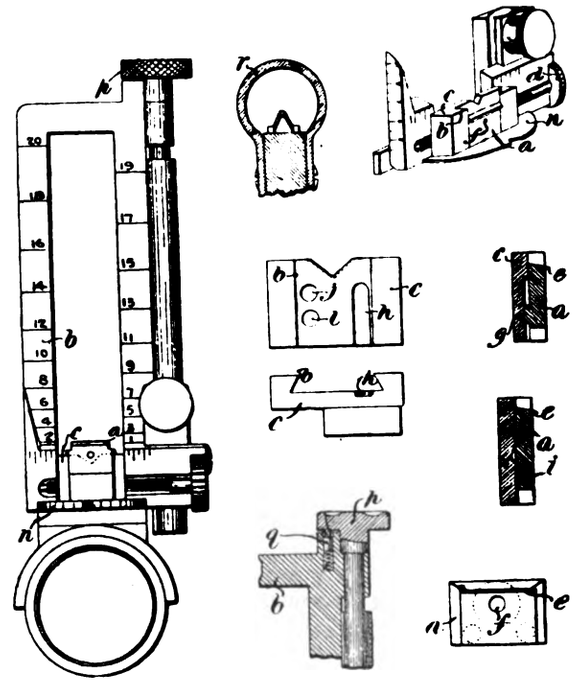


this flat the extension *g* of the slide *c* works and the boss *f* and extension *g* together form a complete circular portion on which the threaded nut *h* works. The threads of the nut engage the threaded top of the slide extension so that when the nut is turned the slide is moved either to the right or to the left. The small pin *i* in the boss *f* works in a slot in the underside of the slide *c* and regulates the travel of the latter. The nut *h* is kept in place by the washer *j* which is held by the rivet *l*.

Graduations or vernier scale markings may be provided as indicated at *n* and *o* and the periphery of the nut *h* may if necessary be divided up to indicate smaller movements of the slide than can be judged by the divisions *n* or *o*. Accepted March 5, 1908.

THE SUTHERLAND WIND GAUGE PEEP SIGHT FOR RIFLES.

7,244 (1907). H. Sefton-Jones, London. (Agent for *M. E. Sutherland, Canada*). This patent particularly concerns a peep or aperture sight attachment for the Sutherland backsight with lateral and vertical screw adjustment which is dealt with in another patent No. 5,254, 1905.



The peep sight slip is illustrated in the drawings here reproduced and it will be seen to consist of the part *a* which works in the dovetail slot *b* cut in the usual v-notch carrying portion *c* of the laterally moveable slide proper. The last named is moved from side to side by means of the screw *d* and thus carries the peep sight slip *a* with it. This slip is provided with the flange *e* by means of which it can be easily worked up or down in its dovetail slot. When the peep hole is to be used the slip *a* is pulled up until the aperture *f* occupies a place in the v-notch. When it is desired to use only a straight bar the slip *a* is pulled up only so far that its top is on a level with the top of the part *c*. The movement of the slip is limited by the engagement of its pin *g* with the slot *h* in the part *c*. The slip is held in either its peep sight or straight bar positions by the entrance of the small spring *i* into the recesses *j* or *l* respectively.

What is called the emergency sight plate is indicated at *n*. This does not participate in the lateral movement of the slide and is therefore always in the central position ready for use at ranges up to 600 when the leaf *o* is folded down on to the ramps.

Another part of the invention concerns a method of indicating movement of the vertical adjustment screw. Beneath the screw head *p* are a number of depressions into which a spring propelled plunger *q* clicks as the head is turned. To take up wear, spring provision is made to pull the screw always in a downward direction.

To provide for very exact sighting the distance between the aperture hole *f* and the top of the slip *a* is so adjusted that when the sighting is correct the hole *f* is concentric with the hood of the foresight hood *r* and when the eye glances over the bar it cannot see the top of the hood. Accepted March 26, 1908.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 189.—Vol. XVI. JUNE, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

Government Inspectors as Private Individuals.—The appointment of Capt. Lloyd to a seat on Messrs. Curtis's and Harvey's board of directors has formed the subject of a question in Parliament, and the reply of the Home Secretary indicates that future appointments will be accompanied by a barring clause in the contract of engagement. It is impossible to resist the feeling that the inspectors of explosives are not the only class of government official who must be classed as enjoying valuable opportunities for acquiring knowledge by virtue of their positions. The conditions of employment by the State are such that the more active and energetic members of the various staffs move in a steady stream towards private employment. The very conditions which constitute a safe job with assured prospects in the eyes of persons of a modestly enterprising temperament act as an incentive to move to another and more arduous sphere when the individual is conscious of a zest for strife and competitive effort. Some of the best intellects in the explosives trade and the industry of arms have been recruited from the government service. It would be invidious to mention names or to establish comparisons, but the fact remains that the army supplies a welcome influx of *personelle* of the highest order to a trade which stands especially in need of trained direction by a high order of intellect. Some slight lack of warmth in the welcome due to Capt. Lloyd may be explained on the ground that some of his experience in explosives—we refuse to ignore his own hard work—has been derived from private firms and not exclusively from the Government establishments as is so often the case. It is, however, difficult to draw distinctions which will stand the test of logical analysis. Surely the Woolwich experts in whom manufacturers confide their latest discoveries receive a higher measure of confidence than private individuals. If a dividing line must separate voluntary from involuntary confidences, then the difficulty is merely shifted to one of definition of words and phrases. The distinction of principle certainly does not exist. The law of the land is absolutely precise on the right of every individual to make a livelihood, and the only possible way of contracting oneself out of what is otherwise an inalienable right is the receipt in hard cash of the money that would be earned by exercising the right to work. Any little soreness which may exist for the moment must rapidly pass away. Meantime the trade as a whole benefits by the inclusion in its numbers of a recruit of high character and sterling ability.

Colonial Factories for Small Arms.—The principle of establishing factories in the various colonies for the manufacture of service rifles and other military requirements is good in many ways, although the commercial results of decentralisation may be unfortunate. Canada has in this respect set the pace by the working of the ammunition factory at Quebec under Col. Gaudet. The situation produced the man, and the man rose well to the occasion. Manufacture in an organised country like England is a very different matter from the running of a works in a situation or country which is not selected on account of special fitness but for strategical reasons. The organisation of a competent staff is but one side of a task which necessitates diving as deeply as a patent law advocate into a variety of abstruse technical problems. One cannot call in an expert to give advice on every crisis, nor can the opportunity exist for securing con-

stant interchange of views with persons similarly situated. Every problem and task must be settled single-handed, and the most arduous personal labour is constantly interrupted by the necessity to deal with small points of discipline and current organisation. By all means let Australia have its rifle factory. The Colonial Ammunition Company, with its semi-official recognition, is a proved success, and the proposal to include rifles, and later on cordite, in the products to be turned out on the spot, will do a great deal to diminish the anxiety that must inevitably be associated with a colony lying so far from the base of the empire. The Australians have on many occasions proved their ability as marksmen, and the very large orders for cadet rifles which that country has placed during the past ten or so years show that there is a large population of rifle users. A Government factory equipped for supplying the service rifle would thus be assured of a plentiful and growing demand. Many profitable orders would be lost to the home firms, but this appears to be one of the instances where the public good must receive first consideration.

Small Bore Developments.—There are signs in several directions that the small-bore shot gun is making more headway than would be the case if it were merely a revival of an old fad. When the charge of shot in a cartridge is diminished the observable difference in the pattern is so small that when examples obtained with each load are examined side by side the ability to distinguish one from the other is more a matter of imagination than fact. The same applies to killing efficiency, and it is not until recoil is considered that any serious difference is noticed. Here, however, it has been conclusively proved that every sixteenth-ounce reduction in the shot charge makes a difference of approximately six ounces in the weight of the gun. Therefore, whilst the loss of efficiency in shooting is much less than the proportionate loss of charge, the gain in gun handiness is definite and pronounced. It has been the custom for many years to use in a gun about fifty times as much shot at each discharge as is necessary for the killing of game. This very generous margin of surplus pellets provides a means of compensating the many sources of inaccuracy which inevitably accompany the shooting of winged game. Apart from the errors of the shooter, there are not only the variations of behaviour in the cartridge, but also the constant errors of the gun itself, all of which diminish, more or less, the shooter's chances for every shot that is fired. The present is not a favourable opportunity for enlarging upon the hidden defects that may be present. The general average efficiency of the guns made during the past ten years is probably many points ahead of those made in the previous decade. Game has not in the interval become materially tougher or more difficult to bag. Hence the extra margin provided by the better quality of the gun has been utilised in increasing the comfort of the shooter by the indirect results which have followed the lessening of the charge of shot. It has already been mentioned that fifty times as much shot is used in a cartridge as is necessary to kill a bird. The lighter shot charges, which are now so popular for 12-bores, reduce this ratio roughly to forty-five times, and the 16-bore will bring it down to forty times. The reduced charge of shot, when delivered from a gun and cartridge calculated to give the highest efficiency in every direction, should prove a highly capable competitor of the larger calibre gun. It is a common practice to regret that there are no more worlds to conquer in the region of mechanical improvements in the double-barrel fowling piece. On the other hand the reduction of a gun's weight by half-a-pound is a very real gain if efficiency remains practically constant. The shooter demands a light gun, but complaints invariably follow its use, and the lightening of charges produces only partial relief. With the 16-bore a permanent reduction of weight can be effected, and the cost is nothing because the increase of handiness is a fair set off against what seems to be a mere paper difference in the charge. These considerations cannot be too closely investigated by everyone who is capable of making experiments and forming unbiassed opinions on the results.

Storage of Safety Explosives.—The Statement by the Home Secretary to the effect that he has noted the resolution passed by the Association of Municipal Corporations, urging the alteration of the law as it affects retail premises registered for the storage of explosives, and that when the present pressure of business relaxes he hopes to appoint a small committee to consider this and other similar questions, will be received with regret by those who may have hoped that a firm refusal would follow any such suggestion. The absence of definiteness of course leaves it open to be supposed that nothing more is intended than a polite shelving of the difficulty. The attitude of the Home Office inspectors, as expressed in the recent report on the subject, is emphatically in favour of not meddling with the present state of the law, but rather of endeavouring to get it better carried out than heretofore, the local authorities being the defaulters. Expert work of this character needs to be carried out by a trained officer who has been taught the principles of the Act so far as it applies to his own work. The inspector should, moreover, receive his instructions from persons who are accustomed to deal with explosives, and who have learned to regard them without the fear which ignorance begets. If, therefore, Mr. Gladstone does appoint a committee with rather wider powers than merely to consider a resolution which was certainly passed by the assembled Association of Municipal Corporations with very little consideration or discussion, that committee will be more likely to recommend the curtailment than the extension of local control over the handling of explosives. The trade does not fear, and will cordially collaborate in making effective, any regulations which are based upon a sane estimate of the risks due to explosive storage. What, however, it would resent, and as far as lay in its power resist, would be any extension of inquisitorial powers by minor police officials who, whatever their capabilities in other directions, are not suitable for inspecting premises, either to decide as to their fitness for explosive storage, or for the purpose of seeing that the rules are being properly carried out.

APERTURE SIGHTS AT BISLEY.

IT is extraordinary how quickly any new development in rifle shooting catches on when once it has become practical politics to the Bisley marksman. Every student of shooting has realised for many years the absurdity of disallowing a peephole on the rifle, whilst permitting its presence on a pair of shooting spectacles. Mr. C. F. Lowe spent a great deal of time and energy fifteen or twenty years ago in proving that the orthoptic aperture was best attached to the rifle, because in that position it acted as a backsight as well as serving the purpose of a definer. The third issue of this paper, viz., that of December 1892, contained the first of two articles from his pen upon sights. The opening article made mention of an ancient crossbow in the museum of the Tower of London bearing a pinhole aperture backsight. This weapon was Mr. Lowe's own discovery, and it was not until he had secured permission from head-quarters that the case containing it was unlocked, whereby he was enabled, after sighting at a chimney-pot, to lay down that our ancestors adopted the pinhole aperture sight as the most practical method of sighting their sporting and military crossbows. Later on in his article he spoke with some impatience concerning the refusal of the National Rifle Association to sanction the use of the aperture at least in all competitions at Bisley open to experimental military rifles. There is no doubt that the Association was guilty of a grave error of judgment in refusing to allow this measure of latitude in regard to the sighting of the class of rifle which falls midway between "service" and "match." The M.B.L., in other words the military breech loader, would have formed a suitable subject for the class of experimentation which would have enabled the rifle enthusiast to devise a weapon where great accuracy of sighting is an all-important consideration. This latitude has always been refused, and team after team has been sent from these shores to compete with foreign riflemen, and they have been beaten upon every occasion because the representatives of Britain were skilled only in shooting a stereotyped service rifle in competition with other teams whose members had been granted the liberty to experiment with special forms of sight and other refinements. Mr. Lowe regretted sixteen years ago that "stick in the mud" was the motto of the Council of the National Rifle Association, whose province it was to encourage rifle shooting throughout the then Queen's dominions. Times have certainly brought welcome changes, for at no period in the history of the National Rifle Association does its ruling council appear to be more open to the absorption of new ideas, and more willing to give them a practical test under competitive conditions, than at the present moment.

Amongst those who endeavour to look a little further ahead than the mere incidents which are engrossing attention at the moment, there is a disposition to regard all the military powers as on the threshold of a sweeping change in the methods of sighting rifles. The increasing flatness of trajectory of military bullets simplifies considerably the problem of sighting by reducing the upstanding height of the backsight, and by increasing the zone of the fixed adjustment. This will permit the lengthening of the sight base from the two-foot distance, common with open sights, to the three-foot distance, which follows more or less when a back aperture is situated near to the eye. The lengthening of the sight base by 50 per cent. necessitates a corresponding increase in the height of the backsight, but the flatter trajectory of the modern high velocity pointed bullets should keep the height of the backsight within reasonable bounds. It is moreover possible that the sights for everyday use, as it were, will only deal with the moderate scale of angle necessitated by working up to say 1,000 yards, and that the more complicated problem incidental to the further distances will be separately treated. Altogether what with the changes which are proceeding in rifles, cartridges and sights it is almost impossible to lay down the precise course which immediate developments will follow. Service rifle competitions must necessarily be closely restricted by definition to what is immediately convenient. The match rifleman on the other hand must always be allowed to experiment rather with barrels and cartridges than with methods of sighting of direct military usefulness. Therefore, once again the intermediate M.B.L. rifle class seems to demand re-establishing with a new set of definitions, so that the class of competitor who is willing to experiment might use special sights suitably safeguarded by definition to ensure keeping on the right track. Such rifles would be of ordinary construction as regards mechanism and magazine, but the barrel might take cartridges giving a very high velocity and very flat trajectory.

That matters have already developed somewhat on the lines here laid down is shown by the recent success of shooters using aperture sights fitted to service rifles, the shooting position being the ordinary prone. The opportunity of indulging in this kind of rifle practice is restricted to those who are willing to compete on an equal footing with the match rifleman who enjoys the superior advantages of telescopic sights and the steadier back position. On a few occasions when the wind is exceptionally changeable the man who occupies the ordinary shooting position which provides a full view of the range whilst engaged in aiming the rifle, will gain a slight advantage, enough perhaps to compensate for the less steady method of holding. Whether match rifle shooting will be strengthened in sporting interest or in actual usefulness by the incursion of shooters adopting the military position it is difficult to say, but one cannot help concluding that the two styles lie wide apart. The match rifleman tests barrels and ammunition, using the best sights and the best position for the purpose, whereas the military or M.B.L. marksman should be employed for finding out the most perfect shooting appliances which can be employed in the ordinary prone position. A few temporary successes may make it appear that the two systems can be treated as one, but the prize list will show the contrary, and this is an argument which the shooter has never been known to ignore.

THE DISCOVERY OF NITRO-STARCH (1833).

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

THE discovery in 1833 by Braconnot (1), Professor of Chemistry in Nancy, of nitro-starch or *xyloïdine* as he called it, and the subsequent work by Pelouze (2) on the same subject is a very interesting prelude to Schönbein's discovery of guncotton in 1846. Immediately after Schönbein's announcement, Pelouze put forward certain claims in the French Academy as regarded the question of priority, claims which Schönbien promptly refuted. In order to allow of a clearer understanding of the historical aspect of the question, and the state of knowledge of the time, the communications of Braconnot and Pelouze are quoted in full in the remainder of the paper.

Braconnot wrote as follows :—

It is well known that dilute nitric acid dissolves potato starch producing a gummy liquid very soluble in water. Quite different results, however, are obtained with concentrated nitric acid. The author has treated 5grms. of starch with a considerable quantity of concentrated nitric acid with continuous agitation. A thick transparent liquid was obtained. This liquid when poured into water throws down a copious, white, curdy precipitate, which, when well washed and dried weighed exactly 5grms. It is white, pulverulent, tasteless and does not redden blue litmus paper. It is coloured brown by a solution of iodine. Bromine, on the other hand, has no action upon it. On boiling with water it is not dissolved, but unites together into a mass. It is not attacked or dissolved by dilute sulphuric acid. Concentrated sulphuric acid produces a clear solution of a gummy nature, which is not precipitated by water. Concentrated hydrochloric acid dissolves it readily especially when heated. The addition of water throws down the original material again, in an unchanged condition. Of all the vegetable acids, acetic acid, alone, reacts with it. It is readily soluble, especially on heating, and so much can be got into solution that the liquid becomes gummy in consistency. In contact with water a white, hard, thick coagulated precipitate is produced. On drying at a low heat a transparent material is obtained, which retains its transparency when placed in water. This thick acid liquid when applied to paper or other materials leaves a very brilliant varnish-like coating, superior to that furnished by the best gums, whilst, at the same time, it is perfectly impervious to water. Linen, coated with this material, retains its impermeability even on boiling with water. These properties show the advantages this material is able to offer in the arts. Boiling wood vinegar dissolves it, and a slight precipitate is thrown down on cooling. Neither ammonia nor caustic potash dissolve it, but they convert it into a transparent body. On boiling a brown solution is obtained, and by neutralisation a precipitate is produced but slightly differing from the original material. It is softened by boiling water without being dissolved and acquires, by drying, the transparency of a gum. On exposing this material to heat it ignites with great readiness. It suffices even to heat it upon a piece of thick paper to produce rapid carbonisation and liquefaction, whilst the cardboard itself, exposed to the heat, is not sensibly damaged. Heated in a small glass retort, it leaves a residue of one-sixth of its weight of carbon, difficult to incinerate, and gives a brownish liquid distillate containing much acetic acid. In contact with a solution of indigo sulphate, largely diluted with water, it is not sensibly coloured blue and does not decolourise the solution. It does not show any indication of reacting with ferric sulphate. As this material appears, in some respects, to resemble lignin, the author proposes for it the name of *Xyloïdine*. Several other vegetable substances are acted on in a similar manner by the addition of nitric acid.

The following observations were made on the action of concentrated nitric acid upon lignin and gummy materials. Sawdust, when acted on by nitric acid, swells up without dissolving. On exposing the mixture to a certain temperature there is no sign of effervescense, which is very remarkable. A gummy solution is obtained so thick that it solidifies on cooling. The addition of water separates abundantly a material precisely similar to that obtained by the action of concentrated nitric acid on starch. Cotton and linen warmed with the same acid are partially dissolved without any sensible reaction and are converted into xyloïdine. Sugar cane, mannite and milk sugar produce nothing, except, in the case of the sugars, a very bitter material. Gum tragacanth, gum arabic, inulin as well as saponin, which the author has discovered in the bark of *gymnocladus canadensis*, are, by the action of nitric acid, converted into xyloïdine. It is true that it is accompanied by a very bitter material from which we may conclude that these gummy materials contain sugar in some form.

In 1838 Pelouze communicated the following results :—

Braconnot noticed, some years ago, that concentrated nitric acid completely altered several substances, notably starch and wood fibre, into quite a new material, which he called xyloïdine. He mixed starch with several times its own weight of nitric acid. When the starch was quite dissolved in the acid, he added water, which immediately separated the xyloïdine in the form of a white, insoluble precipitate, which upon washing and drying, was found to be quite pure. The composition of this substance and the various circumstances which accompany its formation have not been examined. The chief properties have been either imperfectly determined or are completely unknown. My paper will, I hope, make xyloïdine better known, and call the attention of chemists to these interesting points about the chemistry of starch.

If you make a mixture of starch and concentrated nitric acid of a sp. gr. of 1·5, at the end of several minutes, the starch will have completely disappeared. The liquid will still retain the pale yellow colour of concentrated nitric acid and no gas is given off. If water is added immediately, xyloïdine will be completely precipitated and the filtrate, when evaporated, leaves practically no residue. If, instead

of adding water immediately the starch is dissolved in the nitric acid, the solution is left in a closed jar, it changes colour by degrees, and takes the colour of a mixture of nitric acid and oxides of nitrogen. If water is then added, the precipitate of xyloïdine will be found to have greatly diminished. In fact at the end of two days (sometimes even of several hours) no precipitate will be found. The xyloïdine has been entirely destroyed and a completely new acid is formed, which upon evaporation, is found in the form of a solid, white, non-crystalline deliquescent mass, the weight of which is considerably heavier than the starch taken for the experiment. Neither carbonic acid nor oxalic acid is produced during the reaction.

Xyloïdine, the product first produced by the action of nitric acid on starch, is a compound of these two bodies. It may be considered as starch in which a molecule of water has been replaced by a molecule of nitric acid. Starch is completely converted into this body, a fact which explains the considerable increase of weight observed when starch, after being dissolved in nitric acid, is immediately precipitated by water. As an excess of nitric acid converts xyloïdine into a very soluble compound, identical with the new acid which I have previously described, it can be readily understood why Braconnot obtained different results. Braconnot obtained from a given weight of starch the same weight of xyloïdine. It is therefore evident that part of the xyloïdine had been already decomposed as previously described. In fact, should the precipitation of the solution by water not take place till after the lapse of some time, no trace of xyloïdine is obtained. If a mixture of starch and concentrated nitric acid is heated to boiling point, the starch is decomposed in the course of a few minutes and converted into a deliquescent acid which can be obtained in a pure condition by evaporation on the water bath. This acid is the same as I have previously described and contains no nitrogen. It has some points of resemblance to nitro-saccharic acid, but has a different composition. At a moderate heat it is converted into another acid, dark in colour, soluble in water, and converted by nitric acid into the original compound from which it was derived. Concentrated boiling nitric acid only attacks it with difficulty. Nitric acid in the cold converts it gradually into oxalic acid, without production of any carbonic acid. We thus see that starch is converted by the action of nitric acid, successively into xyloïdine, a deliquescent acid, and oxalic acid, without any displacement of the carbon atoms in the compound. I have already remarked, that xyloïdine results from a combination of starch with the elements of nitric acid, producing a compound in which starch may be considered as taking the part of a base. Xyloïdine is extremely combustible, and at a temperature of 180°C it ignites and burns with very considerable violence leaving practically no residue. This property has led me to make certain experiments which I believe, may be of some practical application, particularly in the case of artillery. On dipping paper into nitric acid of a specific gravity of 1·5, allowing sufficient time for the acid to penetrate the paper (two or three minutes is generally sufficient), removing the paper, and washing with a large volume of water, a parchment-like material is obtained, impermeable to moisture, and of extreme combustibility. The same compound is obtained on using linen and cotton fabrics. Paper and fabrics which have thus been submitted to the action of nitric acid owe their new properties to the xyloïdine which covers them.

(1) *Annales de Chem. et Phys.* (1838).
(2) *Comptes Rendus* (1838), 713.

SIZES OF LETTERED SHOT.

THE counting and measuring of shot provide endless amusement for the man with an accurate balance, plenty of spare time, and a certain amount of capacity for arithmetic. These three qualities had to be blended in equal proportions for the compilation of the accompanying table of buck shot and some of the larger wildfowl sizes. It is important for all kinds of experiments to know the diameter which corresponds with a given size of shot as defined by the number of pellets to the ounce. Calculations of striking velocity provide a case in point, but in the matter of buck shot a proper knowledge of the relation between diameter and pellets per ounce is necessary for the correct loading of cartridges.

The present moment is inopportune for dealing in detail with the well-known principles involved in loading buck shot. It is sufficient, therefore, to say that each calibre of cartridge necessitates the use of a certain diameter of pellet according to whether the layer consists of three, four, five and so forth number of pellets as the case may be. Knowing the diameter required it is necessary to translate the value into the only language which is understood in the loading shop or the shot factory, viz., pellets per ounce.

The obvious method of permanently laying down the relation between diameter and pellets per ounce is to build up from experimental observations at various points a curve, from which any intermediate value can be read. For instance, if it was desired to ascertain by measurement the decimal diameter of a size of wildfowl shot running say 40 pellets to the ounce, it would on the face of it be necessary to obtain a sample complying with this specification, and to arrange ten or some larger column of pellets in a row all touching, and divide the total length of the string by the number composing it. The result would be the average diameter per pellet. Whilst this simple method of measuring the average diameter of the pellets composing a particular sample of shot is undoubtedly the best that can be used, it presupposes the existence of a standard sample of shot to be measured. Now in point of fact this is tedious and difficult of achievement, even when the person making the test is provided with a quantity of shot samples, including all the well-known sizes. Each sample is at the best only approximately true to the size marked on the bag or specimen tube according to the quantity available. The No. 6 shot may be an excellent sample running 265 to the ounce, or speaking of buck shot, the S.S.G. may be 18 to the ounce, or 17, but it may be very difficult indeed to find exactly 15 pellets which weigh exactly one ounce.

The same difficulties apply to whatever size of shot may be chosen for examination. Exact observations are necessary for the laying down of sizes which may be accepted by future generations as settling the question once and for all. The curve of relations is nearly horizontal for shots smaller than No. 4, whereas it is nearly vertical for shot running less than 30 to the ounce. The sizes comprised within the critical part of the curve cover the pellets used for wildfowl shooting, and those employed for buck shot loads. In the trade they are known by the very apt descriptive term "lettered" shot to distinguish them from the sizes which are denoted by numbers. It is not good enough to base a curve upon observations so approximate that 19½ pellets per ounce is treated as 19. Moreover a firm may advertise a size of shot as running 180 to the pound, and an actual sample may run less than 10½ to the ounce, the 180 to the pound being equivalent to 11¼ per ounce. The curve must be built up on absolute relations, and whilst it may always be admitted that manufactured sizes must vary within certain limits this need not prevent the curve of relations from expressing theoretical perfection.

Such a curve has been built up, and the following somewhat novel procedure was adopted for arriving at the necessary observation points, through which the curve, expressive of the general law, was drawn:—Samples of each of the better known sizes were spread out in a manner rendering it easy to select by eye judgment alone ten pellets of average roundness and uniform in size. Their exact weight was next taken, and the shifting of the decimal point one place gave the average weight per pellet of the ten tried to the nearest tenth or hundredth of a grain according to the accuracy of the original weighing in quantity. This weight per pellet was divided into the number of grains in an ounce, viz. 437·5, and the answer gave the exact pellets per ounce of each ten selected for experiment. The division should be carried to two places of decimals to achieve a high degree of accuracy. For instance one sample of shot worked out at 27·69 pellets per oz., another 50·87 and a third 7·16. Each value was noted, together with the measured average diameter of the same ten pellets, and they were plotted out in the form of a curve on squared paper. It was surprising to find that the whole of the measurements taken on this system when plotted out and joined together by a truly shaped curve showed a mean deviation of less than half the thousandth part of an inch.

So much work so carefully carried out should not be allowed to remain hidden away in the portfolio in which such drawings are kept. To give permanence to the record for whatever it is worth the diameter for each rise of shot size in terms of pellets per ounce has been read off from the curve, and the values have been set forth in the compact table which is reproduced in the adjoining column:

The table makes it obvious that not only can the diameter of the well known sizes be obtained as a result of joining the observation points by means of a curve, but every size in pellet-per-oz. rises can be read off with the same ease. It is improbable that such a set of values can be of everyday use; but on the other hand they ought to be available for reference purposes by anyone who may wish to verify a particular point in connection with some of the problems that arise in the course of business. The shot trade is presumably unpossessed of these vital statistics of their business, and it is possibly owing to the lack of proper co-ordination that the sizes lists issued by the various makers give so little information to help the user. It is again possible that the lack of study of sizes and all they imply results in the great difficulty which loaders experience in procuring even modest quantities of shot true enough to the size intended, for use in a strict pattern test of a gun. These matters will no doubt right themselves in time to come. In the meanwhile progress may be advanced by defining the underlying rules, and so providing useful material for entering in the notebook, or pasting amongst the collection of newspaper cuttings which are deemed worthy of keeping.

TABLE SHOWING THE RELATION BETWEEN PELLETS PER OUNCE FOR THE LETTERED SIZES OF SHOT, VIZ., SG TO B, AND DIAMETER IN DECIMALS OF AN INCH.

Pellets per oz.	Corresponding Diameter.	Pellets per oz.	Corresponding Diameter.
7	·346	54	·175
8	·333	55	·174
9	·320	56	·173
10	·310	57	·172
11	·301	58	·171
12	·292	59	·170
13	·284	60	·169
14	·276	61	·168
15	·270	62	·167
16	·264	63	·166
17	·258	64	·165
18	·253	65	·164
19	·248	66	·164
20	·244	67	·163
21	·240	68	·162
22	·237	69	·161
23	·234	70	·160
24	·230	71	·159
25	·227	72	·158
26	·224	73	·157
27	·222	74	·156
28	·219	75	·156
29	·217	76	·155
30	·214	77	·154
31	·212	78	·153
32	·210	79	·153
33	·208	80	·152
34	·206	81	·151
35	·204	82	·151
36	·202	83	·150
37	·200	84	·149
38	·198	85	·149
39	·197	86	·148
40	·195	87	·148
41	·193	88	·147
42	·192	89	·146
43	·190	90	·146
44	·188	91	·145
45	·187	92	·145
46	·186	93	·144
47	·184	94	·144
48	·182	95	·143
49	·181	96	·143
50	·180	97	·142
51	·179	98	·142
52	·178	99	·142
53	·176	100	·141

ROUND THE TRADE.

Those who have come into contact with the pleasing personality of Mr. A. W. Greener will regret exceedingly to hear of his death from sudden illness a month ago. He took an active part in the commercial working of the firm's business in Birmingham, where his loss will be very keenly felt. He was the youngest member of the family who so worthily maintain the prestige of the firm.

A picture postcard, which particularly well expresses the appearance and surroundings of the North Western Shooting School has been received from Mr. Charles Lancaster. Being printed by the three colour process due effect has been given to the pleasing greenness which one associates with this ground, for it supplies practically the first glimpse of country which the railway traveller sees when leaving London by the North Western route.

Mr. Alexander Martin of Glasgow, has issued with characteristic promptness an illustrated leaflet showing a variety of sights for use on the service rifle, the same having been submitted and passed for use at the coming Bisley meeting. The screw traverse occupies the leading position. Types in which the vertical adjustment is also screw controlled are more rare, but examples appear, and altogether considering the short notice which has been given the number of types which can be retailed is evidently considerable.

The report and accounts of the E. C. Powder Co., Ld. for the year ended March 31st show a trading profit of £9,935 after deducting office expenses and general distribution charges. The corresponding figure last year was £10,741. The amount brought forward from the last account stands at £3,897, giving a total available of £10,765. Including the interim dividend already paid the shareholders receive a further dividend and bonus making altogether 15 per cent. for the year. This absorbs £7,425, directors' fees take £840 and it is proposed that £1,000 be written off freehold land, the same amount off machinery and plant and that £500 be placed to reserve against investments. The latter stand in the balance sheet at cost, viz., £28,119. The balance to be carried forward is £3,067. At the annual meeting held on the 21st ult., Mr. W. D. Borland received a hearty tribute of recognition for the successful result of his efforts during the past year on the Company's behalf.

The report of the Schultze Gunpowder Co., Ld. shows that last year's working resulted in a loss of £1,065, largely on account of the bad game season which was experienced. Lord Montagu, in presiding at the general meeting of the Company, explained that the position was much better than the balance sheet made it appear. The effect of drastic economies had already begun to be felt, and would be seen more clearly in next year's accounts. In accordance with the recommendations of the committee appointed last year, the staff, both at Eyeworth and in London, had been reorganised and its numbers reduced, by which no less than £2,000 a year would be saved. With regard to the sales, last season was one of the worst, from a game point of view, which had been experienced for many years. Although they sold less powder, they did not suffer to the same degree as might have been anticipated. The loss of £1,065 appearing in the balance-sheet would not have been shown, but, on the contrary, a small profit would have been the result, had not the company, during the past year paid out on account of the Smokeless Powder and Ammunition Company the special sum of £1,174. The cartridge department showed a loss on this year's working, mainly due to the increase in the price of shot. Contracts made, however, for the coming season had been based on terms which should lead to an increased profit of about £1,000. He estimated that about £6,500 would be saved in the current year compared with 1907.

A firm which trades as W. G. Systems Ld., of Craven House, Kingsway, W.C., has forwarded to this office a series of sample sheets of squared paper, all of which are exceptionally accurately drawn and clearly printed. The firm make a speciality of sheets ruled and marked for months and years, the same being intended for the recording of sales, output and other business proceedings in curve form. The constant plotting out of results in curve form is here facilitated by mounting a number of tear off sheets in the pad form.

Mr. F. W. Lightwood, gunmaker of Brigg, Lincolnshire, has forwarded for inspection a gauge for determining the value of doubtful shot holes made with ·22 rifles. It takes the form of a small peg no larger than a watch chain charm which fits into the hole made by the bullet, and so places flush with the surface of the target a circular disc measuring exactly ·22 of an inch. Where the rules lay down that the value of a hit is determined by whether or not the shot has cut the ring, the device is quite effective, particularly so in the case of isolated shot holes.

The firm of Holland & Holland have, according to the *Financier and Bullionist*, "enjoyed a fairly prosperous year, for the ordinary dividend is maintained at the not unsatisfactory rate of 9½ per cent. to which it was reduced from 10 per cent. twelve months ago. The company's distributions have displayed some irregularity in recent years, for, after falling from 11 to 9½ per cent., between 1902 and 1904, and recovering to 10 per cent. in 1905, the rate relapsed to 9½ per cent. in 1906. Fortunately, there has been no further set-back. While maintaining the dividend at 9½ per cent., the directors are able to put £1,000 to reserve, and to increase the carry-forward from £333 to £822."

The fresh appointments on the staff of inspectors under the Explosives Act, necessitated by the death of Captain Thomson and the retirement of Captain Lloyd, have now been made. Major Cooper-Key, as is already well-known, becomes the chief inspector, and Captain Desborough comes next of course in seniority; whilst the new inspectors are Major T. H. Crozier, *p.a.c.*, and Captain H. Coningham, R.A. Major Crozier previously held the appointment of chief instructor of artillery at the Royal Military Academy, Woolwich. Captain Coningham has occupied the position of second military assistant to the chief superintendent of ordnance factories. He is also entitled to place after his name the envied letters *p.a.c.*, which means that he is one of the limited number of officers who have passed the advanced course in the Ordnance College. It is satisfactory to know that two officers, so eminently well fitted by previous training, have been appointed to take their share of the onerous duties which fall to the lot of the explosives inspectors.

The report and accounts of the Hotchkiss Ordnance Co., Ld. show that the profit for last year amounts to £19,378 which, with the amount brought forward, gives a sum available of £21,237. After providing for debenture interest, sinking fund and expenses, the balance remaining becomes £9,264. The second mortgage debenture stock then receives £1,200 and the balance of £8,064 is carried forward. There was an active demand for ordnance in the early part of the year under review, but owing to the financial crisis which occurred in the autumn the business of the Company was adversely affected. Deliveries of ordnance contracted for were delayed, and new contracts which were expected were suspended pending the restoration of normal monetary conditions. In the course of the year a new portable machine gun which has been produced by the technical staff at St. Denis, has given very satisfactory results, and is at present being introduced to various governments. A new type of 3-inch Hotchkiss high power semi-automatic gun has also been produced.

(*Continued on next page.*)

In the course of his remarks at the presentation of prizes to the winners of the national air rifle championship competitions on the 16th ult. Lord Roberts stated that he did not share the disfavour with which air rifle shooting in public-houses was regarded by the War Office. He did not think it would lead men to drink intemperately, because if a man wanted to be a good shot he must not be a good drinker. The withdrawing of official recognition from clubs meeting on licensed premises had removed the exemption from gun licence difficulties. His lordship did not speak sanguinely of the possibility of securing an alteration of the present attitude, but no one need trouble so long as the gun licence is only operative as regards pistols and sporting shooting in the country.

At the meeting of the British South African Explosives Co., Ld., held on the 15th ult., Lord Ribblesdale, who presided dealt very fully with the crisis which had arisen in their business owing to their inability under the present railway tariff in South Africa to make a reasonable profit at the low prices shortly to become operative, and already offered by their competitors. The South African Railway Tariff put them at a disadvantage as compared with other manufacturers in South Africa competing with them for Transvaal trade. The disadvantage at which they were thus placed had become greatly accentuated by the impending establishment of a new explosives factory by competitors on the coast in Natal. If that factory were left with all the advantages of the present tariff, and their own company left with all its disadvantages, there was little prospect of their being able to earn anything like a reasonable trade dividend when their present contract with the mines expired next year. The matter was, to a certain extent, sub judice at present. The question of a return of some of the capital would be considered by the directors between now and the date of the next meeting.

A good deal has been written during the past month on the subject of the international conference which is holding meetings at Brussels for the purpose of considering the present conditions of the traffic in arms with the natives in Africa, not only with regard to the rules themselves, but the actual conditions which exist. It is generally understood that the penny wise economy, which has led to the sale of large quantities of comparatively modern guns, which have been superseded by the adoption of later models, has resulted in natives becoming possessed of weapons having much greater deadliness than was intended when supplies were deliberately restricted to what the Proof House calls African barrels. The matter being one of public interest speculations are rife concerning the possibility of effectively controlling the entry of efficient weapons into the interior of Africa. The *Times*, in commenting on the matter, summarises the position in the following terms :—" It may be taken for granted that they will agree to unexceptionable resolutions. They will have to consider, among other matters, the raising of the import duties on arms and munitions ; the question of the areas within which a prohibitive policy shall be applied ; and the means of enforcing regulations. There are obvious gaps and crevices in articles in the *Acte Général* of the Conference of 1890, and some of them will no doubt be stopped. A large amount of useful experience on the subject has been acquired since that date by England, France, Germany, Portugal, and Italy ; and we may expect that some precise regulations will be formulated. But something more is needed than a string of rules which, though excellent in terms, might have little effect. Each Government concerned in this matter is naturally anxious that the subjects of other Governments shall not engage in the traffic. It is apt to be oblivious or passive as to the conduct of its own people. The zeal which is now expended in criticizing and condemning the action of foreigners might in fact well be kept for home consumption. In particular, attention must be given to the firms which in this country and Germany make a speciality of exporting such arms. They often do much mischief quite unwittingly. They believe it to be no business of theirs to inquire what use is to be made of the weapons which they supply. Few of them would probably persist in the trade it if were brought home to them by direct appeals, enforced occasionally by fine or imprisonment, that they were furnishing weapons likely to be used against their countrymen."

At a meeting of the council of the Birmingham Chamber of Commerce held on the 20th ult. the gun and ammunition trade section presented their report concerning the importation of guns into various countries. It stated that on the recommendation of the section, the chamber had made several representations to the Australian Government with reference to the importation of unproved arms into Australia. In their last report the section dealt with numerous instances of Belgian guns bearing English descriptions being imported into Australia in unfair competition with English guns, and a representation on the subject was made to the Australian Government and had been sympathetically received, the section understanding that the Commonwealth customs authorities intended to see that the law was duly complied with. The section recommended that a further letter be addressed to the Australian government thanking them for the action already taken.

The report of the King's Norton Metal Co., Ld., for the year ended March 31st last, states that in addition to the extremely small amount of Government orders which have been received and the unsatisfactory condition of the metal trade generally, which have caused a large portion of the company's machinery to stand idle, a very heavy loss has taken place owing to the serious depreciation of about £50 a ton in the value of copper. The increased price of coal and of all stores has also contributed to the loss. A considerable outlay on experimental work has also been incurred during the year, and this it has been thought prudent to write off. In consequence of these losses, the directors have transferred from the reserve account for general purposes £35,000, which, with the balance brought forward, makes a total of £35,907. The accounts show a loss of £26,767, in which is included £6,500 applied in reduction of the valuation of the normal stock of copper, to a fixed basis of £41 per ton ; and the amount written off the cost of experimental work is £6,631, thus leaving £2,509. Of this amount the directors have appropriated £2,000 to depreciation, and £509 is carried forward.

The accounts of the Nobel-Dynamite Trust Co., Ld. show a profit for the year ended April 30th last of £263,227 against £319,701 in the previous twelve months. Adding the sum brought forward from the last account the total available is £274,944. Of this amount £25,000 is absorbed by the five per cent. dividend on the preference shares, whilst the ordinary shares receive a dividend of 8 per cent. and a bonus of 2 per cent., together representing £228,540. A sum of £2,000 is set aside for dividend on the new preference shares, and the balance £19,404 is carried forward. The distribution thus remains the same as last year, the only difference being that the carry forward has been augmented to a modest extent whereas £60,000 out of the previous year's profits was transferred by the directors to the reserve fund. According to the report the year under review has been a record one so far as sales by the allied and subsidiary companies have been concerned, but prices have been unsatisfactory, though in some markets they improved towards the end of the year. Orders for war materials have shown a marked decrease, and it is chiefly to this that the decline in profits must be ascribed. The price of raw materials has been high, and the price of coal has likewise adversely affected the cost of production.

LECTURES TO YOUNG GUNMAKERS.

L.—THE RELATION BETWEEN CHRONOGRAPHIC AND STRIKING VELOCITY.

ONE of the largest and most important subjects in sporting gunnery is the relation which exists between velocity as measured by the chronograph, and the velocity with which the pellet strikes the bird. If the existing knowledge on this subject is summarised it will be found that very little information exists for the practical guidance of those who wish to know the precise amount of importance that may be attached to the maintenance in a sporting cartridge of any given chronographic velocity. The term chronographic is used in this sense to imply mean velocity over the usual 20 yards between the muzzle and the velocity wires on the target. During recent years the shooting world generally has become accustomed to regard 1050 f.s. as the velocity of a standard cartridge. A less value is regarded as implying deficient penetration, whilst a higher value is considered as so much gain, provided it does not introduce concurrent disadvantages overpowering the benefits supposed to be derived from high velocity. One hears from time to time an objection lodged against the adoption of a 1050 f.s. standard of velocity on the grounds that any attempt at standardisation creates a prejudice and an inertia against improvements in the upward direction—in fact that a kind of fetish is set up, which is accorded a supreme authority for which there is no justification.

Shooting experience, on the other hand, shows that the greatest evil in sporting cartridges and the most frequent cause of alleged bad penetration is high velocity. Ten years ago everyone endeavoured to combine low pressure and high velocity. To-day the tendency is not exactly in the opposite direction, but there are many indications that it soon will be. The maintenance under all circumstances of a three-ton pressure is far more important than agreement with any given standard of velocity. The powder maker who allows batches to pass into use which give a sufficient velocity but an inadequate pressure is bound in due course to suffer for his sins. The observance of an adequate pressure is the insurance premium which must be paid for protection against most of the elements of misbehaviour in the cartridge, whether they be due to the gun, to the method of loading, or to unfavourable conditions of storage. A high velocity cartridge inevitably produces a heavy recoil in proportion to the amount of shot used. In the presence also of a high velocity there is a vastly increased tendency for the pattern of the gun to become irregular in formation and to display on an undue proportion of occasions the well-known characteristic by the pellets being scattered over an area four or five times greater than the usual amount. High velocity, by destroying the pattern, is thus one of the main causes of what the shooter has been wrongly educated to describe as deficient penetration. Deficient killing power is what he really means. This is, in fact, the only description which the sportsman is justly entitled to apply to his unfavourable experiences, for it is only by tests of velocity and pattern that it is possible to determine in which direction the fault lies.

It seems more than a coincidence that in the large majority of complaints for deficient penetration the chief peculiarity in the cartridges when tried is a consistently high velocity. Complaints of cartridges which actually prove to be deficient in velocity almost invariably take the form not so much of blaming the killing power of the cartridge but rather of pointing out that occasional weak shots are known to occur because the recoil on the shoulder is at times hardly appreciable. There may be a vague feeling of uneasiness, which now and again amounts to positive conviction, that the cartridges are not killing as cleanly as usual. This effect is confirmed by the sensation felt at the shoulder, and if the shooter is well informed technically he may notice other evidences of a badly burnt charge in the form of excessive smoke and an unusual quantity of residue in the barrel. With all these tell-tale evidences of a weak cartridge it is surprising that complaints on this score are not more numerous, but curiously enough powder makers seldom find that complaints of weakness are sustained by practical trials unless by chance the powder is very weak indeed. On the other hand it frequently happens that apparently small variations from standard in the direction of enhanced velocity produce the complaints of lack of penetration already referred to.

In recent issues of the *Field* a certain amount of attention has been devoted to the results obtained with cartridge loads, in which the combination of powder and shot reverses the accepted rules which modern progress has laid down. With the powder charge reduced from 42 grains to 36 grains, and the shot charge increased from 1⅛oz. to 1⅜oz. it would seem as though the perfection which has been attained in the course of so many years of laborious progress should disappear at one swoop, and yet it has been plainly shown that such cartridges possess a variety of merits from the shooters' point of view, especially for those classes of sport where shots at long distances predominate. The extreme may at any rate be regarded as justifying the intermediate stages.

The justification of these remarkable propositions is obvious enough when the necessary tables have been built up to show in terms of striking velocity the exact effect of any given deficiency shown by the chronographic test. In other words arithmetical treatment based upon the well-known laws of air resistance will show the exact effect at 40 yards of any given variation expressed in the terms of the chronographic test. The accompanying table reproduce in compact columns the whole of the results which have been worked out. The four main divisions of the table relate to four grades of cartridge velocity. The behaviour of the standard 1050 f.s. cartridge is duly chronicled, and above and below it are the values for cartridges giving respectively a surplus and a deficit of 50 f.s. Thus, for instance, one may ascertain by looking at the table that the striking velocity at 40 yards of No. 6 shot is 652 f.s. when the cartridge from which it is fired gives the standard

1050 f.s. velocity over 20 yards. With cartridges, in which the 20 yards velocity is only 1000 f.s., the striking velocity is reduced to 631 f.s. When, on the other hand, the velocity is high, viz., 1100 f.s., the striking velocity at 40 yards is increased to 672 f.s.

TABLE OF STRIKING VELOCITY IN FEET-PER-SECOND FOR VARIOUS RANGES AND VARIOUS VELOCITIES OF CARTRIDGE.

SIZE OF SHOT.	RANGE IN YARDS. 20	25	30	35	40	45	50
	Cartridges giving 1100 f.s. velocity over 20 yards.						
7	891	818	753	698	648	603	563
6	**903**	**833**	**773**	**720**	**672**	**628**	**589**
5	915	852	792	741	695	653	615
4	922	862	800	751	704	663	625
3	936	877	823	776	732	692	657
	Cartridges giving 1050 f.s. velocity over 20 yards.						
7	862	792	736	680	632	586	544
6	**872**	**805**	**747**	**698**	**652**	**610**	**573**
5	884	822	767	718	676	635	598
4	887	827	776	729	683	645	608
3	902	844	797	751	710	672	638
	Cartridges giving 1000 f.s. over 20 yards.						
7	826	763	704	654	609	569	532
6	**837**	**775**	**722**	**674**	**631**	**592**	**556**
5	848	790	740	693	652	614	579
4	854	797	747	702	660	623	588
3	866	813	768	725	687	650	618
	Cartridges giving 900 f.s. over 20 yards.						
7	756	700	650	605	565	528	495
6	**765**	**713**	**666**	**623**	**584**	**549**	**517**
5	775	725	681	640	603	569	538
4	781	732	687	647	610	577	546
3	790	744	705	668	633	602	573

The lesson which these figures teach is that a variation of 50 f.s. in the velocity of the cartridge is reduced to about a 20 f.s. surplus or deficit as the case may be in net striking velocity. By comparing one range with another it will be seen that an extra 50 f.s. velocity adds but a miserable two or so yards to the ranging power of the cartridge. In other words even between cartridges having a difference of 100 f.s. in the 20 yards velocity there is merely the distinction that the high velocity cartridge has at 45 yards the velocity of the slower cartridge at 40 yards. One seldom hears it stated that a shooter fails to kill his bird because it was a few yards further away than he imagined. The occasional successful long shot indicates that birds are more often missed on account of the opening out of the pattern than because of the more feeble effects of the pellets as the distance increases. Certainly it seems difficult to resist the conclusion that the very weak cartridge is at least as powerful at 30 yards as the very strong one at 40 yards. Yet a shooter who complains of deficient penetration does not restrict his criticism to the results of shots taken beyond a 30 yards range. All his shooting is supposed to reflect the weakness of the cartridges, yet on the basis of scientific reasoning it is certain that weakness, as defined by the chronograph, is translatable into a very few yards shortening of the killing range of the cartridges.

This is not a question which can be decided once and for all by the quotation of a few statistics from the accompanying table. The whole of the calculated figures are put forward so that persons interested may examine the numerous combinations which suggest themselves to the mind or which have their advocates in the world of sport. Not only must one examine the precise effect produced by variations of velocity, but other combinations must be considered, such, for instance, as the relation between 270 pellets of No. 5½ shot (1⅛oz.), and 270 pellets of No. 6 shot (1oz.). The first charge may be assumed to give a velocity of 1000 f.s., and the second 1100 f.s. At 40 yards the one-ounce charge of No. 6 with the high velocity would have a striking velocity of 672 f.s. At the same distance the No. 5½ shot in the heavier and slower moving charge would have a velocity of about 643 f.s. Thus one cartridge has an advantage in velocity of 30 f.s. in 670, viz., about 4·5 per cent., whereas the other charge is one-eighth heavier, pellet against pellet, which gives an advantage of 12 per cent. The energy formula will enable the person of an enquiring mind to see how the conditions compare in foot-lbs. of striking energy at each distance. The two combinations show a virtual similarity of energy at 40 yards. Just beyond 50 yards the No. 5½ shot gains superiority in energy, whilst with No. 4 the velocity would here be equal and the added weight so much to the good. Thus the historic race between the tortoise and the hare is once more concluded in favour of what is apparently the slower competitor. The general lesson taught by these particular examples is that it is beneficial to increase the weight of the shot charge and the size of the pellet, whilst reducing velocity. Other considerations no doubt favour the opposite combination; but shooting is full of compromises, and the sole purpose of the tables which accompany this lecture is to provide the material for individual enquiry, rather than to lay down hard and fast rules and principles which, upon closer examination, might prove to be out of harmony with certain practical necessities which have previously been overlooked.

THE PROOF HOUSE RETURNS.

LAST year's returns of proofs made at the Birmingham establishment, as summarised in the accompanying table, show a nominal increase on the previous year, and, therefore, a repetition of the upward trend which distinguished the year 1906 from the preceding twelve months. The rise when analysed in respect to the various classifications of arms suggests, so far as it is possible to tell, not merely a question of quantity alone, but an improvement in the proofs of arms commanding a fairly high average price.

Mr. W. L. Powell, the chairman of the trade, in the course of his annual address mentioned that the figures for breech-loading arms had been favourably affected by the demand for English-made cadet rifles of ·22 bore. They had also proved 2,571 foreign-made rifles of this calibre. The last named total represents a decrease on the previous year, and so indicates a growing ability on the part of home firms to supply the needs of miniature rifle shooters in Great

Britain. The total of 4,085 American shot guns is another item which the inside knowledge of the chairman enabled him to quote, although the printed list does not distinguish the totals in so interesting a fashion. It indicates that, although the manufacture of shot guns on the hand-made principle is highly specialised in this country, the market is still injuriously affected by competition from American machine-made arms, especially those of the single-barrel type, with which machinery can more readily deal. Mr. Powell regretted that the recovery of this trade by English gunmakers would be rendered unusually difficult by the inequality of the tariff conditions as they affect the mutual relations of manufacturers and buyers in the two countries.

	1905.	1906.	1907.
Provisional Proofs	**55,380**	**80,522**	**71,910**
Definitive Proofs—			
Muzzle Loaders	31,181	30,307	32,021
African Barrels	110,615	62,632	57,431
Breech Loading Arms ..	57,658	74,273	91,695
Nitro Proof of Rifle Barrels	1,492	2,031	2,585
Express Rifle Barrels ..	637	520	660
Military Rifle Barrels ..	7,094	16,964	29,578
Chambers of Revolvers ..	48,200	55,479	37,703
Pistols	530	14,241	11,675
Sundries	448	1,009	683
Supplementary Proofs—			
Nitro Proof	23,803	32,190	35,219
Proved with Nitros ..	419	360	275
	337,457	**370,528**	**371,435**

The continued decline of proofs in revolvers represents a very serious diminution of business. Even allowing that the bulk of the falling off arises from the restrictions enforced under the Pistols Act on the sales of cheap foreign revolvers, there can be no doubt that the continued failure of orders from the Government is a serious factor in the commercial situation, and one which should not be accounted for on the assumption that the revolver has lost some of its favour as a military weapon. It still occupies a very important position in the arming of those whose duties are inconsistent with the carrying of a rifle.

Mr. W. H. Hughes, who seconded the adoption of the report mentions that information had just reached him to the effect that the Australian government had just passed a law subjecting to a heavy extra import duty on guns that did not bear an authorized prool mark. This would, he anticipated, result in the formation of an American proof house. In common with other speakers he dealt with the injustice done to British gunmakers by the practice so common in Belgium of marking guns with trade marks in English and suggestive of an English origin. It was regarded as most important to endeavour to convince the colonies of the wisdom in their own interests of preventing the importation of guns marked in a manner calculated to make the purchaser suppose that they were of English origin.

The report of the Gun Trade Technical School, which is issued at the same time as the proof house report in the form of a separate leaflet contains full particulars of the year's work. The record of attendances is satisfactory, as also is the progress made by the individual pupils, but one may hope as time goes on that a larger proportion of the young men in the trade will take advantage of the facilities provided.

APPLICATIONS FOR PATENTS.

APRIL 21—MAY 23, 1908.

8,772.* Ordnance Cartridges. Fried Krupp.
8,776.* Shrapnel. F. W. F. Schultz.
8,784. Silencer for Guns. E. Roszkowski.
8,847. Model Naval Gun for Shooting Galleries. T. Medhurst.
8,872. Sighting Devices. W. J. Jeffery.
8,892.* Automatic Falling Targets. G. Bresztovsky.
8,894.* Gun Carriage Recoil Mechanism. H. C. L. Holden.
8,895.* Electrical Firing Mechanism. H. C. L. Holden.
8,990.* Cartridge Packing Machine. A. J. Boult.
9,052. Field Firing Targets. R. T. Gates.
9,143.* Breech-blocks for Magazine Arms. T. A. Fidjeland.
9,259. Blasting Explosive Wrappers. Kynoch Ld. and J. P. Udal.
9,316. Firearms Gas Check. T. Gilbert-Russell.
9,431. Small Arm Sights. B.S.A. Co. Ld. and G. Norman.
9,448.* Fuse Setting Machines. Fried Krupp.
9,459. Inserting Primers in Cartridge Cases. Nobel's Explosives Co., Ld., and H. D. Hodge.
9,460. Inserting Anvils into Primers. Nobel's Explosives Co., Ld., and H. D. Hodge.
9,462. Feeding Cartridge Cases. Nobel's Explosives Co., Ld., and H. D. Hodge.
9,521.* Safety Device for Fuses. E. Schneider.
9,623. Guncotton Manufacture. G. W. Bell.
9,644. Prevention of Double Discharge. F. Leedale.
9,734.* Barrel Recoil Ordnance Carriages. Fried Krupp.
9,854. Automatic Machine Guns. T. Keppel.
9,906. Range Finders. A. Barr and W. Stroud.
9,978. Explosive Projectile Fuses. J. C. Thompson.
10,021.* Automatic Machine Guns. E. C. R. Marks.
10,111. Ammunition Hoists. A. T. Dawson and J. Horne.
10,129.* Preventing Spontaneous Explosion. E. Bauchaud-Praceiq.
10,146. Bolt Fastening. R. W. Glanville.
10,204.* Cartridge Shell Feeding Machines. H. D. Hodge.
10,205. Small Arms Sights. M. Blood.
10,222.* Repeating Firearms. A. W. Schwarzlose.
10,228.* Firearms. F. D. Ely.
10,229.* Projectiles. R. Naglo.
10,250. Ordnance. C. Hickton and W. P. Smith.
10,256. Ordnance. A. Bremberg.
10,264. Projectile Fuses. H. V. Cuthbert-Keeson.
10,268. Drop-Down Small Arms. F. S. Cox.
10,297.* Projectile Fuses. E. Schneider.
10,312.* Elevating Apparatus of Light Guns. A. Vickers.
10,389. Rifle Sights. C. E. Gudgeon.
10,418.* Machine Guns. G. E. Dymond.
10,426.* Cartridge Loading Machines. A. J. Boult.
10,505. Ordnance Sighting Gear. Armstrong, Whitworth, F. G. D. Johnston, and J. Richardson.
10,589. Mounting of Rifle Sights. L. R. Tippins.
10,623.* Firearms Indicator. O. Imray.
10,624.* Firing Pin Locking Device. O. Imray.
10,639. Gun Mountings. A. F. Petch and R. Redpath.
10,698.* Recoil Loading Guns. W. Fairweather.
10,703. Ordnance Ammunition Loading Apparatus. A. T. Dawson and J. Horne.
10,797.* Safety Trigger Device. H. Stephan and C. Lenz.
10,947.* Ordnance Ramming Apparatus. E. Schneider.
10,965.* Warning Protector against Spontaneous Explosions. J. C. E. Bouchaud-Praceiq.
11,020. Aperture Rifle Sights. H. W. Brownsdon and H. Melville Smith.
11,057.* Automobile Gun Mounts. W. P. Thompson.
11,108.* Barrel Recoil Ordnance. Fried Krupp.
11,172. Firearms. H. Flasche.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

APRIL 23—MAY 21, 1908.

COMPILED BY HENRY TARRANT.

23,993 (1906). **Automatic Firearm Breech Mechanism.** L. Mertens, Berlin. An "Inertia block" is arranged in the breech to move forward at the moment of firing at half the momentum of the projectile when the latter leaves the barrel. This moving block absorbs a good deal of the recoil. To equalize gas pressure on the neck of the cartridge case channels leading from the barrel admit gas to a cut away space outside the shoulders. The destruction of the case is prevented in this way. Accepted April 16, 1908.

3,420 (1907). **Running-Out Gear for Heavy Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. An air cylinder and hollow ram are provided independent of the recoil absorbing apparatus. The air cylinder is charged before firing with compressed air or gas at such a pressure as to ensure the running out of the gun after recoil to any angle of elevation. Accepted April 11, 1908.

7,716 (1907). **Naval Target.** Commander W. F. Pamphlett, R.N., London. A naval target carrier is so constructed that the felt target proper is supported entirely in front of the raft. Danger of splinters perforating the target are thus obviated. Felt or other such non-woven material is used instead of canvas. Accepted April 2, 1908.

7,797 (1907). **Ammunition Hoisting Apparatus for Heavy Ordnance.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. The powder hoist is of the endless chain type and an intermittent motion is imparted to an auxiliary chain whereby the powder charge receiver at the top of the hoist is intermittently rotated to bring unfilled powder receptacles into place. Accepted April 2, 1908.

8,554 (1907). **The Holland-Woodward Single-trigger Mechanism.** H. W. Holland and T. Woodward, London. (*See Selected Patents*).

8,575 (1907). **Dummies for Sword Practice.** Lieut.-Col. B. R. Dietz, Canterbury. A dummy representing a man is built up mainly of straw and is erected on a support capable of rotating, having a flexible or resilient connection with a block adapted to be inserted in the ground. Accepted April 9, 1908.

9,160 (1907). **Percussion Fuse.** F. M. Hale, Catford. The firing needle of a percussion fuse is held securely until the impact of the shell. The part holding it is sheared when the shell is suddenly stopped, the needle is driven forward and by the time the exploder charge has burnt through sufficiently to ignite the main charge the shell is well through the armour plate. Accepted April 23, 1908.

9,770 (1907). **Target Practice Apparatus.** A. A. Adams, U.S.A. Apparatus of the "sub-target" type, in which the relative motion between the marker and the sub-target is magnified as compared with the actual deflection of the aiming device. By altering the length of the cord connecting the gun and the target the sub-target can be moved towards or away from the marker. Accepted April 23, 1908.

10,298 (1907). **Self-registering Target.** T. Edwards, Chippenham. The target described in this patent is shown in conjunction with a spring gun. When the bull is struck a pencil mark is automatically made on a card behind the target. Accepted April 16, 1908.

12,021 (1907). **Projectile Construction.** S. Rogozea, France. In patent No. 8038. 1907, is described a projectile which fits over the barrel of the firearm. The modified form fits inside the barrel but allows of the application of the forces of the gases at the centre of gravity of the bullet. Accepted April 9, 1908.

12,684 (1907). **Moving Targets.** H. P. Jones, Dolgelley. By means of clock work mechanism a target is moved in a lateral direction and is caused by rise or fall at different positions by the movement of the frame on which its works. Accepted April 16, 1908.

14,447 (1907). **Pneumatic Gun.** J. Lucking, London. (Agent for *G. Pabst, Germany*). Compressed air or gas is stored in the butt of the gun described in this patent. The sliding interior of the barrel is pulled outwards against the action of a spring so that when the trigger is pulled the sliding portion is forceably pulled inwards again, strikes a valve and releases a certain amount of compressed gas to expel the muzzle loaded projectile. Accepted April 16, 1908.

15,112 (1907). **Ordnance Recoil Brakes.** Fried Krupp, A.-G., Germany. Two separate and independent appliances are provided for adjusting the fluid pressure brake, by means of one of which an automatic setting is effected when the gun is being elevated and by means of the other the brake may be set by hand. Patents Nos. 3087, 1906, 6587, 1907, and 5289, 1907, are mentioned as having a bearing on one or other of the points in this connection. Accepted April 23, 1908.

16,607 (1907). **Small Arm Projectiles and Barrels.** C. Puff, Germany. (*See Selected Patents*).

16,898 (1907). **Adjustable Back Sight for Rifles.** W. J. C. Downey, Western Australia. By means of a screw running through the lower part of this backsight for rifles the whole leaf and the slide may be laterally traversed. For rough adjustments the slide may be moved rapidly up or down the leaf by pressing a half nut out of engagement with the vertical screw column. When rough adjustment has been made the vertical screw is operated to obtain finer vertical adjustments. At the top of the leaf a disc is fixed with four apertures of various sizes. Either may be turned into position for use instead of the ordinary V notch. Accepted April 9, 1908.

18,188 (1907). **Automatic Pistol.** A. W. Schwarzlose, Berlin. The automatic pistol dealt with in this patent has a forwardly sliding barrel which is constructed in one piece with the casing receiving the closing spring. The magazine is specially constructed to allow the cartridges to be withdrawn one by one by a moving extension at the back of the barrel. Accepted April 16, 1908.

19,993 (1907). **Nitrate of Ammonia Explosive.** V. Ansay, and C. Nameche, Belgium. An explosive consisting of 90% of nitrate of ammonia or nitrate of soda and 10% of nitrified mineral resin is claimed to be healthy to manufacture because no nitrous vapors are given off during nitrification and volatile products among the nitrified compounds are absent. The nitrified resin is obtained by the nitrification of the raw residue of the distillation of coal tar by means of sulpho-nitric acid. Accepted April 2, 1908.

20,455 (1907). **Semi-Automatic Small Arm.** R. Frommer, Hungary. Provision is made in this mechanism for the rapid disengagement of the breech block return spring so that the weapon may be used as an ordinary hand manipulated. The turning of the bolt handle out of the way automatically replaces the parts in position for automatic firing. Accepted April 23, 1908.

22,647 (1907). **Ammunition Wagon.** Rheinische und Mf. Germany. This ammunition wagon does not need tipping to unload. It retains the same position in transport and during firing, and is claimed to retain the advantages of other wagons which need tipping. The shot on cartridges are packed horizontally and the box is extended below the axle. Accepted April 30, 1908.

24,212 (1907). **Self-registering Targets.** J. Y. Johnson, London. (Agent for *Felten & Guilleaume-Lahmeyerwerke A.-G., Germany*). This self recording target relies upon the completion of an electrical circuit by the touching simultaneously by the bullet of two of the parallel metallic strips composing the target face. Accepted April 9, 1908.

24,754 (1907). **Automatic Rifle Mechanism.** J. Warnant Créon, Belgium. Part of the energy of recoil is transferred through a new limb to the hammer so that barrel and breech remain locked together sufficient time to enable the gases to impart the greatest possible velocity to the bullet. Accepted April 30, 1908.

26,791 (1907). **A Liquid Explosive.** W. S. Winchester, U.S.A. What is claimed to be stronger than nitro glycerine, safer to handle, and practically non-freezing consists of a mixture of 1 part of picric acid dissolved in 7 parts of mono-

nitro-benzine. About 3 parts of this mixture are dissolved at 86°F. in 96–97 parts of nitroglycerine. These ingredients are thoroughly mixed by stirring and half a part of gum camphor may be added. Accepted April 23, 1908.

27,296 (1907). **Combination Leaf Sight.** P. Jensen, London. (Agent for *The Lyman Gun Sight Corporation, U.S.A.*) An ordinary leaf sight working on a hinge pin is provided with a laterally moveable part by means of which a series of sight notches of different forms may be brought into the sighting position. Accepted April 9, 1908.

27,442 (1907). **Wedge Breech Mechanism for Ordnance.** Fried Krupp, A.-G., Germany. This patent relates to the type of wedge breech mechanism in which the opening and closing of the breech is effected by means of a transport screw carried in the breech wedge. A catch is provided for securing the hand crank in a position of rest. April 16, 1908.

28,177 (1907). **Automatic Pistols.** N. Pieper, Liege. Improvements are described in the pistol mechanism described in patent No. 9379a, 1905. The present invention relates to the application of the fastening of the cut away locking pin type dealt with in Patent No. 9379, 1905, by means of which dismounting and assembling are facilitated. Accepted April 9, 1908.

28,609 (1907). **Fuse Setting Machine.** F. Krupp, A.-G., Germany. Fuse setting machine with two concentric setting bodies in which only one revolution of the crank is necessary. The shock action is not greater it is stated that it is in the fuse setting machine with two complete revolutions of the crank. The two setting bodies are connected with the crank so that they rotate in opposite directions when the fuse is being set. Accepted April 9, 1908.

219 (1908). **Machine Guns Sights.** A. G. Bloxam, London. (Agent for *Deutsche Waffen-und-Munitionsfabrik, Berlin*). The telescope of a machine gun is mounted on a foot plate which is directly attached to the gun, but which is adjustable in all directions. Accepted April 16, 1908.

868 (1908). **Barrel Recoil Ordnance.** G. Hayn, and N. Koch, Germany. Barrel recoil ordnance the arrangements of which enable it to be loaded in the recoil position and fired on running out, and in which the axis about which the gun barrel rocks when elevated lies in the vicinity of the breech of the gun when situated in the recoil position. Accepted April 16, 1908.

1,408 (1908). **Fuse Setting Key.** Fried Krupp, A.-G., Germany. Improvements in the form of fuse setting key described in patent No. 16,852, 1907. The bolt can be thrown out of operation by hand so as to enable the key to be lifted off the fuse when the fuse is being set. Accepted April 2, 1908.

4,136 (1908). **Sharpnel Shells.** Rheinische Metallwaaren und Mf., Germany. In a shell for ordnance containing both a shrapnel charge and filling and a high explosive the balls are packed in a high explosive which detonates when the grenade charge detonates, but only burns when the shrapnel charge explodes. Accepted April 9, 1908.

SELECTED PATENTS.

THE HOLLAND-WOODWARD SINGLE TRIGGER MECHANISM.

8,554 (1907). H. W. Holland, London, and T. Woodward, Willesden. In the various existing single trigger mechanisms for double-barelled guns, a slide or catch is usually provided to stop the involuntary pull (following the first discharge) from firing the second barrel. In the mechanism dealt with in this patent the catch is held up against the trigger (a sufficient time after the first discharge to nullify the involuntary pull) by a rod fixed to a diaphragm at the end of a pneumatic chamber.

The novel parts are clearly illustrated in the appended reproductions. When the gun is opened for reloading the rod *a* is turned on its pivot *b* and its hooked rear end is caused to engage the cam *c* on the part *d* and to pull that part forward to the position illustrated in Fig. 1. Here it is held until the trigger is pulled. The upward movement of the trigger carries the hook out of engagement with the part *d*, but the recoil from the discharge is responsible for the forward movement of the piston

Fig. 1

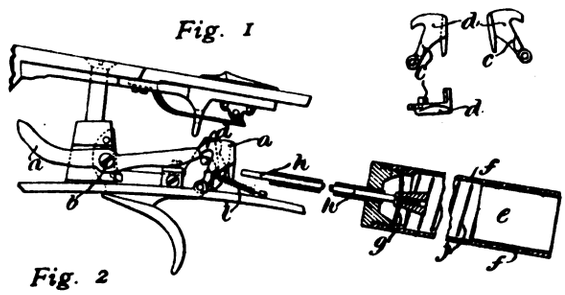
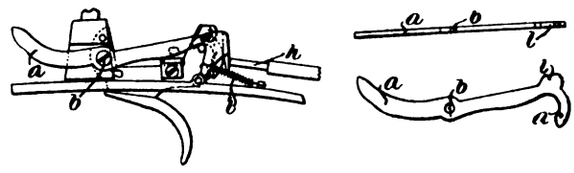


Fig. 2



e on the cylinder *f* situated at the back of the mechanism. The movement of the piston compresses the air behind the parchment diaphragm *g* and impels the rod *h* forward so that its end abuts against the back of the part *d* and prevents the spring *i* pulling the part *d* back out of the way of the trigger. The rod holds the part *d* in its forward position long enough to prevent the involuntary pull lifting the trigger sufficiently high to reach the sear of the second barrel. The piston *e* is regulated by the spring *j* and the hanging leg of the "safety" engages with the hump *l* on the lever *a* when the mechanism is locked. Accepted April 2, 1908.

SMALL ARM PROJECTILES AND BARRELS.

16,607 (1907). C. Puff, Germany. The patentee describes and illustrates his method of imparting more energy than usual to a projectile given a certain gas pressure, and it consists in providing the rear end of the bullet with a driving plate or disc larger in sectional area than the bullet proper. The disc is either compressed by rifling grooves of progressive depth to the area of the bullet proper during the travel of the projectile through the first portion of the barrel, or it is automatically disengaged from the bullet when the last named reaches the muzzle. The following is extracted from the patent specification:—"When the diameter of the bore of the barrel is 7·9 mm. the depth of the groove which is necessary for insuring the guidance of the projectile is say 0·1 mm. the width of the groove is 4 mm. so that the diameter of the bore from one groove to the opposite one is 8·1 mm. When these grooves are deepened according to the present invention to 0·7 mm., there are four grooves, each 4·0 mm. wide, an increase of the sectional area of 0·7 mm. × 4 × 4 = 11·2 mm². If for a diameter of bore of 7·9 mm. and a diameter of grooves of 8·1 mm. the sectional area of the projectile upon which act the gases of the powder, is approximately 50·26 mm.², this area is in the example shown 50·26 + 11·2 = 61·46 mm.² or the charge of the section is for a weight of the projectile of 14·7gr. $= \frac{14{\cdot}7}{50{\cdot}26} = {\cdot}298$ or $\frac{14{\cdot}7}{61{\cdot}46} = 0{\cdot}239$. The charge on the section is therefore for a section of 61·46, 0·059 or say $\frac{1}{5}$ less than for a section of 50·26 whereby the gas pressure is considerably reduced, or the speed of the projectile is increased, if the gas pressure remains the same. The present invention is based upon the above stated effective phenomena which occur inside the barrel during the firing and are well known to any person skilled in the art of ballistics.

With a view to attaining the above stated results the deepened parts of the grooves may be continued to the mouth of the barrel or they may be converted after a determined length into the grooves of normal depth or into the bore. In the first instance the projectiles must be provided with a driving disc which separates itself from the projectile when the latter reaches the mouth of the barrel so as to prevent the projecting surfaces of

the driving disc which until now filled the depth of the grooves, from increasing the air resistance which would have a hindering action on the projectile, whilst in the second instance, where the deepened parts of the grooves are converted in the bore itself into grooves of normal depth, the projectile is preferably provided with fixed collars which in the normal part of the grooves corresponding to the bore may be compressed so as to assume the thickness of the calibre proper.

The grooves need not always be deepened directly in the barrel itself; a special replaceable part may be provided at or in the rear part of the barrel, this special part containing the seat for the cartridge and the deeper part of the grooves which may be or not helicoidally arranged.

I am aware that firearms have already been constructed which have been provided with grooves becoming flatter towards the front end of the barrel or having a different section which decreases towards the mouth of the barrel. These well known arrangements of the barrel bore have solely for their object to allow the projectile to enter more easily the grooves of the barrel, to avoid thus the rubbing off or the wear and tear of the lead with a view of preventing on the one hand as much as possible the barrel being clogged when the lead projectiles are fired, and on the other hand of providing a tight closure for the gases between the projectile and the barrel wall, owing to the fact that the guiding material is securely pressed during the movement of the projectile against the inner wall of the barrel bore in the grooves which become slightly narrower towards the mouth."

Fig. 1

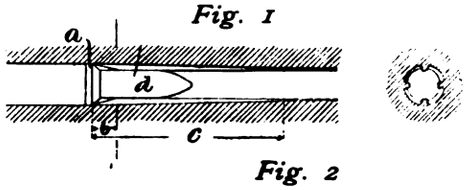


Fig. 2

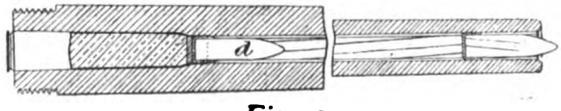
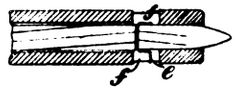


Fig. 3



The bore and projectile are illustrated in the drawings here shown. In Fig. 1 the size of the collar *a* is exaggerated the more clearly to explain it. The part *b* of the bore is the "transition cone" formed by bevelling the rear ends of the rifling lands. The length *c* of the deepened part of the grooves may be varied to suit different conditions, and the lands may taper towards their rear ends so that they may the more easily cut into the driving disc *a*. The latter may be compressed down to the size of the body *d* of the projectile or, as is illustrated in Fig. 2, it may be merely mounted on the bullet so that the two separate when the bullet leaves the muzzle. Fig. 3 shows a construction in which the bore is narrowed at the muzzle and is not provided with grooves in front of the openings *f*. In this case the driving disc *e* is slid off the bullet end when the bullet arrives at the openings and either falls through one or is impelled upwards through the other. Several other forms of driving discs are shown in the specification.

At the conclusion of his specification the inventor adds:—

"Those parts which form the enlarged pressure surface do not need to be secured to the projectile, they may also be secured in the cartridge case which plan may especially be adapted in artillery ammunition where the powder and the projectile are separated. The driving disc or the like secured in the cartridge case may be provided, for instance for heavy cannons, with notches adapted to facilitate the introduction of the projecting parts or lands of the barrel bore and to reduce friction. In order that these notches exactly correspond to the projecting surfaces or lands of the barrel bore, the driving disc is provided with a mark such as for instance a notch or its equivalent, arranged in a corresponding manner on the cartridge case and corresponding to a fixed mark provided at the rear part of the gun or the like." Accepted April 16, 1908.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 190.—Vol. XVI. JULY, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

Olympic Rifle Shooting.—It is difficult to give a precise date to the opening of the Bisley Meeting, in so far that many of the occupants of the camp will take up their residence on the 8th inst. The rifle shooting contests in connection with the Olympic Games take place during the three days preceding the ordinary Bisley meeting. Teams from many countries will compete, and whether the spectacular or the trade point of view is considered, the shooters and their weapons will be far more interesting than anything which the ordinary meeting can show. To comply with the requirements of Continental shooters the ordinary Bisley distances have been abandoned, and the specification of rifles has been changed, so that the home team will suffer from a greater feeling of strangeness than any of the visitors. The pistol competitions will similarly take place under rules which have never appeared in a Bisley programme. Accuracy, no matter how attained, is the dominating idea of all the competitions, and shooters indulge in many strange freaks in their efforts to secure a perfect result. Great changes may in due course follow from the demonstration of foreign methods of rifle shooting. The miniature marksman is struggling to combine sport with the carrying on of a pastime which is subsidised because of its national utility. Variety in the programme of competitions is of very great importance if the interest of members is to be retained. If the Olympic Games meeting shows how programmes may be extended by adding the best features of Continental methods great good will result. From the ·22 rifle to the military ranges is a step which few shooters can afford to take without Government aid, and as the civilian marksman prefers entire freedom in the pursuit of his sport, the 300 metres style of shooting seems to be of a kind which could be carried on under ordinary club conditions without undue difficulty in securing range accomodation.

Miniature Pistol Practice.—Mention has just been made of the importance of paying great attention to the conditions of rifle shooting which will be disclosed by the Olympic Games preceding the Bisley Meeting. The same applies with almost greater force to the pistol competitions. The shooting instinct turns much more naturally to the pistol than the rifle. The boy's first ambition is to possess a revolver, and it is not until he has gained experience of the high cost of the ammunition, and the only moderate accuracy attainable, that he turns to the rifle as complying more closely with what he finds to be his requirements. The longing to become a good pistol shot remains in the mind for many years to come, but the Bisley Regulations have ordained that serious pistol shooting cannot take place at a less distance than 20 yards, also that the calibre must be ·450 and the mechanism of the revolver type. Other pistols are admittedly used, but only in competitions heavily subsidised by the manufacturer anxious to promote their sale, and no one has regarded the sale of small calibre pistols of sufficient importance to justify the expense of initiating their use. The Pistols Act has struck a serious blow at the existence of all pocket arms, but when Olympic regulations and target shooting requirements have been met it will be found that the pistol of competition has ceased to be a pistol according to the Act of Parliament definition. A weapon with a barrel exceeding nine inches in length—and twelve seems to be the favoured length for target practice—is en-

tirely outside the provisions of the Pistols Act, which is directed solely against the highly portable weapon having a barrel from two to six inches long. The definition in the Act was obviously framed to include all *bona fide* pistols intended to be used as such. There is no justification, outside target practice, for a weapon with a barrel of greater length than nine inches. It is surprising that manufacturers have not already supplied a pistol with a 9½-inch barrel. It would serve many of the legitimate uses which the Act unduly restricts, and at the same time its ungainliness would prevent a recurrence of the evils which led to the passing of the existing Act. If, therefore, manufacturers could see their way to place on the market a legitimate pistol with a 10 or 12-inch barrel, of a design which would not provoke an amending Act, good trade should result. The Olympic Games will no doubt show that the ·22 calibre cartridge is the best for the purpose.

Shooting Prospects.—In so far that all the game shooting reports hark back to the weather experienced during the previous June, so it is now possible to lay down, not only that the past month has been singularly free from devastating rain storms, but also that the general conditions have been, and still remain, exceptionally favourable from the point of view of the game preserver. The prolongation of the ordinary winter made a late spring, and nesting operations were delayed, with the result that the bad snow storm of May did less damage than was at first supposed. The alternations of sunshine and rain which have marked the month of June have resulted in a record hay crop. For the game preserver this implies plenty of insect food, and an absence of the large earth cracks which produce a mortality amongst partridge chicks when the spring is unduly dry. All things considered, therefore, the prospects are exceedingly good, and good prospects should in due course produce good results. With a plentiful supply of game, and general indications of an improved money situation, it seems probable that the total business done will achieve an important advance on recent seasons. Large sales will certainly be required to liquidate the quantities of unused cartridges for which there was no use, and, therefore, no sale, last season. The retailer will take his delayed profit in the ordinary course, but the manufacturer and the middleman will suffer so long as the ordinary rate of output is checked by unsold stocks. The better the season the more quickly will normal conditions be re-established, and it is pleasant at any rate to be able to reflect that the first and most critical stage in the making of a shooting season has been successfully passed.

Our Fifty-first Lecture.—From small and hesitating beginnings the series of Lectures to Young Gunmakers, which was commenced in November 1899, has just completed the first half century, the second fifty having now commenced. The actual subject discussed this month is of extraordinary interest from a scientific point of view. The gun which dispenses with the use of gunpowder ought to be a dangerous combination to recommend on the part of anyone having a concurrent interest in the prosperity of the powder trade. Such narrowness of outlook is, however, out of character with the kind of competition which the air-rifle wages against gunpowder propulsion. In point of fact the air-rifle is the missionary which unobtrusively preaches the gospel of shooting to the tyro. The fascination of the sport which the air-rifle exemplifies produces its result in a short space of time, a result which is materially assisted by the improved accuracy of the modern air-rifle. This accuracy has been mostly achieved as a result of mechanical improvements, and no one can say that progress has yet reached its ultimate limit. The more in fact that the subject is examined scientifically the more certain does it seem that improvements having far-reaching effects are almost in sight. The ordinary routine in developments of this kind will no doubt be followed. The scientific man endeavours to find out the reason why, and when he is satisfied as to the cause, he makes known his discovery. The practical man then begins to turn the matter over in his mind with a view to possible improvements. Such a lecture as the one which appears this month contains a number of measurements which may assist in defining the science of the air-rifle. The ostensible object in view was the building up of a trajectory table for use in garden shooting, but the preliminary enquiry led to certain measurements being made and certain comparisons being instituted, from which it really would appear that a decided opening existed for improving upon present methods, excellent though they may be.

The New Patent Rules.—It is rather unfortunate, but in no way harmful, that the new Patent Act should have been made the subject of political strife, one side maintaining that its object is protective, the other that it merely extends the principle of free trade. That both parties should quarrel over the measure after it has passed into law is in the peculiar conditions of the case a most valuable testimony to the satisfactory results which have followed the working out of the new regulations. The enterprise of foreign manufacturers has been in no wise diminished by the restriction of their power to control the British market without contributing to the manufacturing enterprise of the country. Since the Act was passed into active working the owners of patents believed to be valuable have worked hard to get them taken up by British firms. The patents which have not formed the subject of special endeavours are inferentially condemned as worthless, and in a few years time the number of live foreign patents will be greatly diminished. No downward tendency in the statistics of patents taken out has yet manifested itself, at any rate so far as the report for last year by the Comptroller General is concerned. There are for the moment no definite signs that the trade in small arms will derive material on account of a desire on the part of German, Belgian or American firms to prolong the vitality of their patents by securing English working. The ordnance trade will doubtless be greatly relieved by the diminished necessity to steer clear in new designs of the parallel contrivances of Continental firms working on the same problems. On the other hand new patents are as plentiful as ever, which suggests that the five years of certain life is a valuable consideration.

CLAY BIRD SHOOTING.

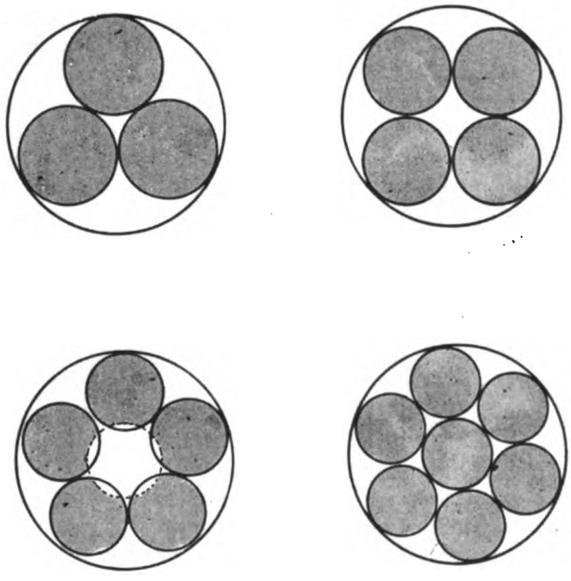
THE fact that this month there will be held at the Uxendon Shooting School an international clay bird shooting meeting, at which representative teams from Finland, Greece, Belgium, Holland, France, Canada and the United Kingdom will take part, raises an important question concerning the future of trap shooting in Great Britain. Live bird shooting has practically been killed as a result of the decision to discontinue this branch of the sporting activities of Hurlingham. From the gunmaker's point of view, the decision arrived at, unfortunately, goes very much farther than the membership of this fashionable circle of sportsmen. Pigeon shooting has been declared bad form, and it has accordingly lost the sanction of fashion which enabled the smaller type of sportsman to organise an annual pigeon shoot among his sporting friends and acquaintances with prizes added by patrons in the neighbourhood. Gamekeepers and sporting publicans were especially prominent as organisers of these gatherings, and small as the influence of these meetings might at first sight seem to be they nevertheless, formed the sole incentive for a certain class of shooter to be equipped with a good quality of gun. Such an incident as the disappearance of pigeon shooting could be borne with equanimity if a tendency to adopt some other kind of target was manifest. Clay pigeon shooting on the club system has developed a particular kind of alertness and skill which, though they may not be difficult to acquire, their mastery presents more difficulties to the average good shot than successful participation in a pigeon shoot. The clay bird presents a small mark to the eye, and it is possessed with the one idea of getting out of range as quickly as possible. The pigeon on the other hand in rising from the trap calls attentions to its presence by a large amount of fluttering, following which it strikes off in one direction or another, not necessarily away from the shooter, but nearly always presenting a good sporting shot which it is a pleasure to bring off. For clay bird shooting, as carried on under club conditions, a full-choke gun is a far greater necessity than is the case with live birds, where it is the custom to handicap by distance, and so level up the less successful shooters by minimising the difficulties they are called upon to face.

Club clay bird shooting in this country suffers more or less from the legacy of trade influence which dominated the conditions which were originally laid down. If clay bird shooting had been intended to benefit the cartridge maker alone the gunmaker should have been excluded from consideration by encouraging the use of single-barrel guns. These could have been produced at a very low price with long chambers and the necessary amount of choke to give effective killing results. Sport would then have developed on American lines, and it is possible that a worthy substitute for pigeon shooting would now be available. The governing body of the Clay Bird Shooting Association was mainly influenced by the principle of first catching the club member, and then seeing that he fired the greatest possible number of rounds in the course of the afternoon. The shooters were accordingly arranged in lines, and the report of discharge, preferably, both barrels, was the signal for the next bird to be released and so on down the line until each shooter had fired his ten shots, the succeeding team being held in readiness to take their places the moment the last man in the preceding team had fired his last shot. This summary of the methods, which still hold wherever clay bird shooting is carried on, is not intended so much in condemnation of the prevailing system as for the purpose of drawing attention to the need of something more closely resembling the informal village shoot which has for object the shooting of pigeons, starlings, or sparrows, as the case may be. The system of shooting in teams necessitates an elaborately equipped ground and either a large concourse of shooters, or else a smaller gathering of exceedingly keen and comparatively wealthy shooters. In favour of the team system is the fact that it is the only possible one for large gatherings in the nature of inter-club contests and championship meetings. In condemnation of the indiscriminate firing it produces is the fact that it was primarily ordained with a view of encouraging a large consumption of ammunition, the result of which has been that clay bird shooting is restricted to a few highly organised clubs whose aggregate effect on trade is small.

The shooting schools have developed a most interesting and valuable means of obtaining practice with the gun by the organised use of clay birds, and some of them, notably the London Sporting Park, have endeavoured with great ingenuity to devise an efficient substitute for ordinary pigeon shooting. Unfortunately the result does not appear to have been particularly successful. Possibly it is because nature supplied the pigeon with wings with which to fly, whereas capital and mechanical skill combined are necessary to provide sporting shots by means of inanimate targets. It is very difficult when so many intelligent men have done their best to say for certain why they have failed, or to suggest alternative methods which promise a greater measure of success. The authorisation in all rules of single barrel shooting and pigeon cartridges and loads, side by side with the double-barrel system for those who elect to retain old methods, should pave the way for the introduction of new blood by diminishing the first outlay on a suitable gun. The adoption of the single-fire system under suitably framed conditions, and with a less costly outfit than that now specified, all to be designed with a view to the entertainment of small gatherings of shooters who assemble as much for sociality as for shooting, should produce a certain amount of effect. At the present moment, with the example provided by almost every county but our own, there is undoubted evidence that clay bird shooting does possess some of the best elements of sport. As a factor in trade turnover it is nearly a dead letter, except as regards gun fitting and game shooting practice. If the consumption of cartridges can be safeguarded, even at the cost of sacrificing the sale of double guns, every effort should be made to save a dead loss, for it is surely better to retain the part than lose the whole.

BUCK-SHOT SIZES FOR ALL BORES.

IN supplement to the statistics which were published last month, showing the decimal diameter of every size of lettered shot advancing in pellet-per-ounce stages, two additional tables are now given by way of a further instalment of the information governing buck shot loads. The sizes of shot suitable for the purpose are strictly limited to the four simple geometrical arrangements which are illustrated in the accompanying diagrams. Only those sizes of buck shot can be used in any given calibre of cartridge which will pack in a case giving exactly 3, 4, 5 or 7 pellets in each layer.



The number of layers is determined by the amount of shot charge required, but this aspect of the question is secondary to the more important one of knowing exactly which sizes of buck shot are appropriate for a given calibre of gun. Colonel Journée has given the whole of the particulars for French measures and sizes, but his figures unfortunately take no account of the English shot notation which distinguishes the sizes accordingly to the number of pellets to the ounce. Table I accordingly shows, for all the calibres from 4-bore to ·410-bore, the diameter, in decimals of an inch, of the pellets which will exactly fit the case, whether the pellets lie 3, 4, 5 or 7 in a layer as the case may be. These sizes are obtained by arithmetical calculation based upon the known relation which exists between the diameter of a circle and the diameter of the smaller circles arranged inside the same and touching at all points. Table II. translates these sizes into the popularly understood pellets-per-ounce description of size. It does not follow that the shot maker is in the habit of stocking all the sizes specified in the table. This, however, is beside the point for the moment, the present idea being to show the best sizes of shot to use, irrespectively as to whether they are obtainable or not.

TABLE I.—**Diameters of Buck-Shot Pellets for all Bores.**

Bore of Gun.	Decimal Calibre.	Three in layer. ·46 of cal.	Four in layer. ·41 of cal.	Five in layer. ·87 of cal.	Seven in layer. 1-3rd of cal.
	inch.	inch.	inch	inch.	inch
4	**·935**	·430	·383	·346	·312
8	**·835**	·384	·342	·309	·278
10	**·775**	·356	·318	·287	·258
12	**·729**	·335	·299	·270	·243
14	**·693**	·319	·284	·256	·231
16	**·662**	·305	·271	·245	·221
20	**·615**	·283	·252	·228	·205
24	**·579**	·266	·237	·214	·193
28	**·550**	·253	·226	·204	·183
32	**·502**	·231	·206	·186	·167
·410	**·410**	·189	·168	·152	·137

TABLE II.—**Buck-Shot Sizes in Pellets-per-oz. for all Bores.**

Bore of Gun.	Three in layer.	Four in layer.	Five in layer.	Seven in layer.
4	3·4	5·0	7·0	9·8
8	5·0	7·2	10·1	13·8
10	6·4	9·2	12·6	17·0
12	7·8	11·2	15·0	20·3
14	9·1	13·0	17·4	23·8
16	10·6	14·8	19·8	27·3
20	13·1	18·2	24·7	34·5
24	15·7	22·0	30·0	41·0
28	18·0	25·3	35·0	47·5
32	23·8	34·0	46·0	62·0
·410	43·5	61·0	80·0	109·0

The arrangement of buck shot which gives three pellets in a layer is not so much used as the four-layer arrangement. Three pellets in a 12-bore cartridge necessitates a size of shot running 7·8 to the ounce, S.G. at 8 pellets being the appropriate commercial size. Three layers, making nine pellets all told, represent 1⅛oz. exactly, and the charge is one which should prove highly effective for many classes of shooting. Even though the three-layer arrangement may give an unnecessarily large size of pellet when a 12-bore gun is in question, the same arrangement in a 16-bore may prove to give the most favourable possible conditions. Curiously enough the size of pellet which suits the four-layer arrangement in a 12-bore, viz., 11 to the ounce, would exactly suit a16-bore using the three-layer system of loading. This size is described by Walkers Parker as special S.G., and it is the one which the Winchester Company supply when buck shot cartridges are ordered. The same size, though perhaps a trifle loose, would suit the 8-bore cartridge when loaded five in a layer. No other size seems to possess the all-round usefulness of the special S.G., though S.S.G. (15 pellets per ounce), which gives five in a layer with a 12-bore, will pack very nicely in a 16-bore with one less in the layer.

The few coincidences of this kind to be met with in glancing through the values shown in Table II. indicate clearly that buck shot sizes must consist of a necessarily odd looking series of graduations, with wide and narrow gaps, following apparently no particular system. The only proper method of arriving at an understanding of the figures which Table II. contains is to set them out in descending order, naming the loads from which each is appropriate.

The following asbtract from Table II. shows to what extent the same sizes can be used under varying conditions :—

5·0	pellets	per	ounce	gives	4	per	layer in a	4-bore.
5·3	,,	,,	,,	,,	3	,,	,, 8	,,
6·4	,,	,,	,,	,,	3	,,	,, 10	,,
7·0	,,	,,	,,	,,	5	,,	,, 4	,,
7·2	,,	,,	,,	,,	4	,,	,, 8	,,
7·8	,,	,,	,,	,,	3	,,	,, 12	,,
9·2	,,	,,	,,	,,	4	,,	,, 10	,,
10·1	,,	,,	,,	,,	5	,,	,, 8	,,
10·6	,,	,,	,,	,,	3	,,	,, 16	,,
11·2	,,	,,	,,	,,	4	,,	,, 12	,,
12·6	,,	,,	,,	,,	5	,,	,, 10	,,
13·1	,,	,,	,,	,,	3	,,	,, 20	,,
14·8	,,	,,	,,	,,	4	,,	,, 16	,,
15·0	,,	,,	,,	,,	5	,,	,, 12	,,
18·2	,,	,,	,,	,,	4	,,	,, 20	,,
19·8	,,	,,	,,	,,	5	,,	,, 16	,,
24·7	,,	,,	,,	,,	5	,,	,, 20	,,

By restricting the number of bores considered to those likely to be generally used for firing buck shot it will be seen that the number of necessary sizes of pellet has been brought within reasonable limits. It must of course be understood that whilst it is admissible to use a smaller size of buck shot than that specified in the Tables I. and II., larger sizes can only be authorised when the margin of difference is very small. When considering shot sizes according to a pellets-per-ounce scale it is well to remember that the larger number indicates the smaller size. There will then be no difficulty in appreciating that a cartridge which requires pellets running 10·6 to the ounce will take with an easy fit pellets running 11 to the ounce.

It should be clearly understood that the sizes recommended in the various tables here reproduced have been based on the proof house minimum calibre of each bore. The interior of the cartridge case into which the shot would thus be loaded is larger than the assumed bore, whilst so far as any choke at the muzzle is concerned, that must be smaller.

THE DISCOVERY OF GUN COTTON (1846).

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

Christian Frederick Schönbein, the discoverer of guncotton, was born on Oct. 18, 1799 at Metzingen, Wurtemburg, and died on Aug. 29, 1868 at Sauersberg near Baden-Baden. He was Professor of Chemistry at Bâle, and announced his discovery of guncotton on May 27, 1846, at a meeting of the Society of Scientific Research at Bâle.

The steps leading up to the discovery, as well as the attitude taken up by Schönbein to certain claims made by Pelouze in the French Academy, as regards priority, may be best appreciated by quoting Schönbein himself.(*)

" The substance to which I have given in Germany the name *Schiesswolle*, and in English that of guncotton, having excited a lively curiosity, it may be interesting to the scientific world to become acquainted with some details of the way in which I was first led to its discovery. The results of my researches on ozone led me in the last few years to turn my attention particularly to the oxides of nitrogen and principally to nitric acid. The numerous experiments which I have made on this subject have led me, as I have stated in detail in *Poggendorff's Annalen*, to adopt a peculiar hypothesis of the so-called hydrates of nitric acid, sulphuric acid, etc., as well as the normal nitrates, sulphates, etc. For a long time I have entertained doubts as to the existence of compound bodies of this nature, which cannot be isolated, and which are stated to be capable of existing only in combination with certain other substances. For a long time, also, I had come to the conclusion that the introduction of these imaginary combinations had only been an apparent progress in theoretical chemistry and that it had even impeded its development. It is well known that what has most contributed to the admission of the existence of these compounds has been the opinion generally received among chemists respecting the nature of nitric acid. (Here follows a discussion on the constitution of nitric and sulphuric acids). My experiments on ozone have shown that this body forms a peculiar compound with olefiant gas, without apparently oxidising in the least either the hydrogen or the carbon of the gas. I had an idea that it would not be impossible that certain organic matters, exposed to a low temperature, would likewise form compounds, either with ozone alone, which, on my hypothesis, occurs in a state of combination or mixture in the acid mixture, or with NO_4. It was this conjecture (doubtless very singular in the eyes of chemists) which principally led me to commence experiments with common sugar.

" I made a mixture of 1 volume of nitric acid (1·5) and 2 volumes of sulphuric acid (1·85), and cooled the mixture to 0°C. I then added some finely powdered sugar so as to form a paste. I stirred the whole and at the end of a few minutes the saccharine substance formed itself into a viscous mass, entirely separated from the acid liquid, without any disengagement of gas. The pasty mass was washed with boiling water until the latter no longer showed any acid reaction ; after which I deprived it as much as possible, at a low temperature, of the water which it still retained. The substance now possessed the following properties :—Exposed to a low temperature it is hard and brittle ; at a moderate temperature it may be moulded like jalap resin, which gives it a beautifully silky lustre. It is semi-fluid at 100°C ; at higher temperatures it gives off red vapour. Heated still more, it suddenly deflagrates with violence, without leaving any perceptible residue. It is almost insipid and colourless, transparent like the resins, almost insoluble in water, but easily soluble in essential oils, ether and concentrated nitric acid, and in most cases it acts in general, like the resins from the chemical and physical point of view. Friction, for instance, renders it electrical. It should be added that the acid mixture, by means of which this resinous body was obtained, has an extremely marked bitter taste. I wished to make experiments also with other organic substances, and I soon discovered, one after another,

*Archives des Sciences Physiques et Naturelles (1846).

all those about which there has been so much said of late in the French Academy. All this occurred in December 1845, and the first few months of 1846. In March I sent specimens of my new compound to some of my friends, especially Faraday, Herschel and Grove. It is necessary to note expressly that guncotton formed part of these products; but I must add that hardly was it discovered when I employed it in shooting experiments, the success of which encouraged me to continue them. Accepting the obliging invitation which I received I went to Wurtemburg, in the middle of April, and made experiments with guncotton, both in the Arsenal at Ludwigsburg, in the presence of artillery officers, and at Stuttgart before the King himself. In the course of May, June and July, with the kind co-operation of Commandant de Mechel, M. Burkhardt, captain of artillery, and other officers, I subsequently made in Bâle, numerous experiments with arms of small calibre, such as pistols, carbines, etc., and afterwards with mortars and cannon, experiments at which Baron de Krüdener, the Russian Ambassador, was several times present. I may be allowed to mention that I was the person who fired the first cannon loaded with guncotton and shot, on July 28, 1846, after we had previously ascertained by experiment with mortars that the substance in question was capable of being used with pieces of large calibre. About the same time, and independently, I employed guncotton to blast some rocks at Istein, in the Grand Duchy of Baden, and to blow up some old walls at Bâle, and in both cases I had opportunities of convincing myself in the most satisfactory manner of the superiority of this new explosive over gunpowder. In July I made also the first capsules and employed them with success for muskets in the presence of the above named officers. Experiments of this kind, which took place frequently and in the presence of a great number of persons could not long remain unknown, and the public journals soon gave, without participation on my part, descriptions more or less accurate of the results which I obtained. This circumstance, joined to the short notice which I inserted in the May number of *Poggendorff's Annalen* could not fail to attract the attention of German chemists. In the middle of August I received from Böttger, Professor at Frankfort, the news that he had succeeded in preparing guncotton and other substances. Our two names thus became associated in the discovery of the substance in question. To Böttger, guncotton must have been particularly interesting as he had previously discovered an organic acid which deflagrated readily. In August I went to England, where, assisted by the able engineer, Richard Taylor of Falmouth, I made numerous experiments in the mines of Cornwall which were entirely successful in the opinion of all competent witnesses. Experiments on the action of guncotton were also made in several parts of England under my directions, both with small fire-arms and pieces of artillery, and the results obtained were very satisfactory.

"Until that time there had been little or nothing said of guncotton in France; and it would appear that the short notice which Grove gave at Southampton at the meeting of the British Association, and the experiments with which he accompanied them, served first to attract the attention of French chemists to this substance. At Paris the thing was at first considered hardly credible, and jokes even were passed upon it. But when there could no longer remain any doubt as to the reality of the discovery, and when several chemists in Germany and other countries had published the processes which they employed to prepare guncotton, then a lively interest was manifested in a subject which had just before excited derision, and it was soon pretended that the new explosive was an old French discovery. It was declared to be nothing more than the xylöidine first discovered by Braconnot and afterwards investigated anew by Pelouze, (*Arms & Explosives*, June, 1908), and the only merit left to me was to have conceived the happy idea of putting this substance into a gunbarrel. The knowledge of the composition of xylöidine ought to have sufficed to have convinced those who put forward that opinion, that it is not suited for firearms on account of its containing too much carbon and too little oxygen, for the chief part to be converted into gaseous matters during the combustion. It was, moreover, very easy to discover the essential differences which exist between xylöidine and guncotton. Nevertheless the error was kept up for some months. Matters stood thus when on Nov. 4 last, a Scotch chemist, Walter Crum of Glasgow, published a memoir in which he showed that guncotton is not the same product as xylöidine, but that it presents an essentially different composition, and towards the end of the same month the French Academy received a communication of the same nature. The guncotton was no longer xylöidine, it was called *pyroxyline*, and the first was admitted to be unsuitable for firearms. If, therefore, it is proved that from the commencement of 1846, I prepared guncotton and applied it to the discharge of firearms, and that Böttger did the same in August—if it be admitted that xylöidine cannot serve the same purpose as guncotton, and if it be notoriously known that what is now called pyroxyline was not brought before the French Academy and the world until towards the middle of November last, the idea of attributing to France the discovery of guncotton cannot be seriously entertained, or of assigning to me merely a practical application of that which another had discovered. I appeal to the justice of Frenchmen to decide the point to whom belongs the honour, of not only being the first to apply the new substance in question but also of having first prepared it—to Braconnot and Pelouze or myself. I must, moreover, add expressly that it was not xyloidine, even, which led to my discovery, however intimate may be its relations with guncotton. It was theoretical ideas, possibly very erroneous ones, but which are peculiarly my own, as well as some facts which I was also the first to discover. *Suum cuique* is a principle of morality on which society at large rests; why should it not be strictly respected in the republic of science? Pelouze is a distinguished chemist and already possesses a sufficiently high reputation, not to require to elevate his pretensions on the merits of others; and I am fully persuaded that this esteemed chemist, of well known truth of character, will, approaching with impartiality the circumstances which have occurred, freely render me the justice to which I consider myself entitled."

ROUND THE TRADE.

The directors of the Cotton Powder Co., Ld. have declared a dividend of five per cent, on the ordinary shares.

Mr. Harry E. Palmer, formerly partner in the firm of Messrs. W. and H. E. Palmer, gunmakers, of Rochester, has been appointed to fill a vacancy in the travelling staff of the firm of Eley Bros., Ld.

According to the list of birthday honours Prof. A. G. Greenhill, F.R.S. has been made a knight, which is a well deserved tribute to one whose great mathematical genius has been devoted to the elucidation of gunnery problems.

Mr. Rowland Watson, gunmaker, of Whittall Street, Birmingham, has forwarded to this office woodcut proofs showing the external appearance and internal working of a side-lock hammerless gun to the planning of which he has devoted considerable attention.

Messrs. Curtis's and Harvey, in spite of the extraordinary, though of course, not exceptional, care with which they administer their factories, have been particularly unlucky in having an undue share of explosions. At the Cliffe works on the 10th ult. an explosion occurred in one of the nitroglycerine buildings which resulted in the death of two employees who were engaged at the time in filling mining cartridges.

The Transvaal Weekly Illustrated contains some views of the Modderfontein dynamite factory taken on the occasion of a recent visit by the members of the Transvaal Chamber of Mines. An effective group on the steps of a pleasantly treed terrace shows Mr. Cullen, the general manager, Mr. Hosken, the managing director, Mr. Phillips, the President of the visiting Chamber, and last, but not least, Mrs. Cullen.

The annual report and accounts of the Gunmakers Association for the year ended March 31st last, was presented to the general meeting on the 15th ult., and duly passed. The report, which is marked "Confidential, for members only," deals in detail with the noteworthy events of the year under review of which the Association has had cause to take cognisance. The matters in question are extremely well laid out, and they emphasize the value of these annual reports as a record of progress in all that concerns the interests of the gun trade.

At the general meeting of the New Explosives, Co., Ld., Mr. E. H. Hindley congratulated the shareholders on the satisfactory result of the year's trading, a four-per-cent. distribution, in view of the conditions which had prevailed, being a result which the Company was fortunate in achieving. The possibility of earning any profit depended upon the ability to buy the raw materials in the best markets and at the best time. Business in blasting compounds had been quiet owing to the distinct slackening in the metal trade. Beyond the contracts executed for foreign Governments they had been fairly busy with the manufacture of cordite for the Home Government. Mr. W. W. de Buriatte seconded the resolution, which was carried.

Messrs. Kynoch, Ld. have forwarded to this office a copy of their new season's catalogue which has ceased to be of the album size, being now reduced to 8½ins. high by 5½ins. wide. The illustrations are as effectively printed as in former years. The vocabulary of invented words is steadily increasing, "Sallinoid" being the latest addition to the Shadrack series. The instructions concerning price maintained goods are detailed and precise, the Company definitely inviting traders to support the scheme by refusing to deal with wholesale firms who have not adopted this principle of conducting business. A careful search through its pages fails to reveal the useful tables of rifle statistics which made the previous issues so valuable as a source of information.

The next sale of guns and other sporting tackle will take place at Debenham's rooms on Friday, the 3rd inst.

The Eley list of price maintained cartridges is given in a single-page leaflet, from which it appears that the minimum retail selling price for *Aquoid* Waterproof is 10s. 6d. *Zenith* Gastight, 10s., *Acme* 9s., *Ecar* nitro 8s. 6d., Eley smokeless cartridge 7s. 10d., *Vulcan* 6s. 10d.

Mr. Robert B. Pollitt has signed an agreement with the Campañia Nacional Mexicana de Dinamite y Explosivos, and according to his last letter received at this office he was due to sail for Mexico on the 6th ult., where his address will be Dinamita (via Noé), Durango, Mexico.

Mr. Wm. Horton, gunmaker, of Glasgow has issued in pamphlet form a reprint of his own and other contributions to the vigourous correspondence on gun fitting which took place in *The Field* at the beginning of the present year. He opens the subject with a series of well written introductory pages.

Under the title of *The British Miniature Rifle* Mr. Greener has issued a shilling booklet, published by R. A. Everett & Co., in which he recapitulates the elementary aspects of miniature rifle shooting, with here and there practical observations based on gunmaking knowledge which represent the outcome of considerable experience. All told it gives very good value for the money, being particularly useful as a guide for users of ·22 rifles having Martini actions.

Year by year the tendency of gunmakers to follow the fashion set by many branches of west end trade in moving into side thoroughfares, and relying upon other methods of making their goods known than the occupation of expensive frontages, will shortly be exemplified by the migration of Messrs. Boss to 13 Dover Street, Piccadilly, and Messrs. Rigby to Sackville Street, off the same thoroughfare. The change is in both instances necessitated by the expiration of the leases governing the block of buildings in which the two firms named had premises.

THE London Small Arms Co., Ld., have forwarded a model of the War Office miniature rifle fitted with their new windgauge peepsight. This consists of a disc fixed on an upright stem following the plan adopted with the Lyman and other similar American sights. The bed is fixed to the comb of the stock and elevation is given by means of a knurled collar or nut. A windgauge traversing motion is imparted to the aperture by means of mechanism contained within the eyecup disc. This consists of a dovetail recess, along which a sliding piece travels, carrying with it the aperture through which aim is taken. Adjustment is given by rotating the disc. Consequently the shooter is in a position to control from his backsight both the vertical and the lateral adjustments.

The following statement concerning the position of the well-known firm of Pieper has been forwarded to this office with the request that it should be published:—"The firm of Etablissements Pieper, successors to H. Pieper and manufacturers of the well-known Pieper guns was reorganised in 1905 with a capital stock of fcs. 2,000,000. On this occasion the name of the firm underwent a slight change and reads now as follows: Anciens Etablissements Pieper, Herstal-lez-Liége, Belgium. The firm used to have two factories, one of which was located at Liége, Rue des Bayards 24, and the other one at Nessonvaux in the valley of the Vesdre, which is famous for its barrel welding industry. In 1907 the directors decided to build an entirely new factory at Herstal, a suburb of Liége, and at present 1,000 hands are employed there. In addition to the making of double barrel hammer and hammerless shotguns the firm has undertaken the manufacturing of automatic firearms. A large order for automatic pistols from the Spanish Government is actually being worked on, and the firm will soon bring out a semi-automatic ·22 calibre Flobert rifle, which it is hoped, will meet with a large sale."

LECTURES TO YOUNG GUNMAKERS.

LI.—THE TRAJECTORY OF AIR RIFLES.

THE general tendency of the incidental shooting carried on in this country is to use rifles of ever diminishing power in order to reduce the chances of accidents. Whilst the ·22 rifle has largely ousted the larger bores for rook, rabbit and small bird shooting in the fields and farmlands of the open country, the air rifle has become the accepted garden weapon on account of the practically complete absence of danger so long as the user reasonably controls the directions in which aim is taken. The practical effects produced by the small slugs which these weapons project by means of compressed air are astonishing great; but it is also evident, especially in open country, that the range of accuracy of the air-rifle is extremely small, owing to the rapid fall for distances beyond about 25 yards. The shooter would be better able to allow for the fall of his bullet if he possessed a properly worked out table of trajectory. The purpose of the present lecture is, therefore, to place on record certain important statistics concerning the behaviour of air-rifles, basing thereon a table of trajectory which should prove useful to all air gunners.

First and foremost it was necessary to gather statistics concerning the behaviour of various weights of slug in the better known models of air-rifle. In order to keep the enquiry within reasonable bounds two rifles and three brands of slug were treated as sufficiently covering the combinations requiring consideration. The original idea was to establish a ground work of practical observations, upon which calculated values could be based, but difficulties cropped up as the experiments proceeded. These troubles do not, however, diminish the interest of the facts which have already been garnered, though it admittedly is desirable to reserve for future treatment the question of harmonising the trajectories observed with the well known laws for air resistance. The slugs selected for experiment comprised the two kinds made by Kynoch's, viz., the "Match" and the "Witton," and a slug of similar design to the Witton recently placed on the market by the Birmingham Metal and Munitions Company. The Match slug weighs 9·6 grains, taking the average of a hundred weighed at a time, whilst the Witton and the B.M.M. slugs both weigh exactly 8 grains. The match slug is dearer than the Witton, and is supposed to be a more highly refined piece of work, but club air-gun shooters are credited with preferring the Witton slug. Tests of velocity and trajectory confirm their choice; the former by showing that the lighter slug has a much higher velocity, and the latter by showing that the trajectory is flatter, or at any rate not less flat at the comparatively distant range of 50 yards. All the three slugs are notable for extreme accuracy of dimension and regularity of weight.

As regards the rifles used, the B.S.A., as made under the Lincoln Jeffries patent, is already so well known that it is sufficient to state that it was used in the tests, the other rifle being the Kynoch model, which is the same as the B.S.A. in regard to the vital dimensions of most of the working parts. It has, however, been recently suggested that the Kynoch air-rifle gives a materially higher velocity than its competitor. This contention has been sustained by practical experiments, though it is difficult at first sight to see how the difference arises. The following details of the springs of the two rifles show that no material distinction can be drawn in regard to the source of propulsive energy :—

TABLE I.—COMPARISON OF B.S.A. AND KYNOCH AIR-RIFLE SPRINGS.

	KYNOCH.	B.S.A.	
		Single.	Double.
Length uncompressed ..	10·2 in.	10·4 in.	10·2 in.
,, with 28 lbs. load ..	9·2 ,,	9·3 ,,	9·0 ,,
,, ,, 56 ,, ,, ..	8·3 ,,	8·2 ,,	8·0 ,,
,, ,, 70 ,, ,, ..	7·9 ,,	7·7 ,,	7·5 ,,

From the details above given it will be obvious that the differences between the springs used in the two rifles are limited to the accidental characteristics of the particular samples chosen for the test. The design of the rifle necessarily controls the amount of compression of the spring before and after discharge, also the distance of movement —in other words the stroke. These elements are here sorted out in tabular form :—

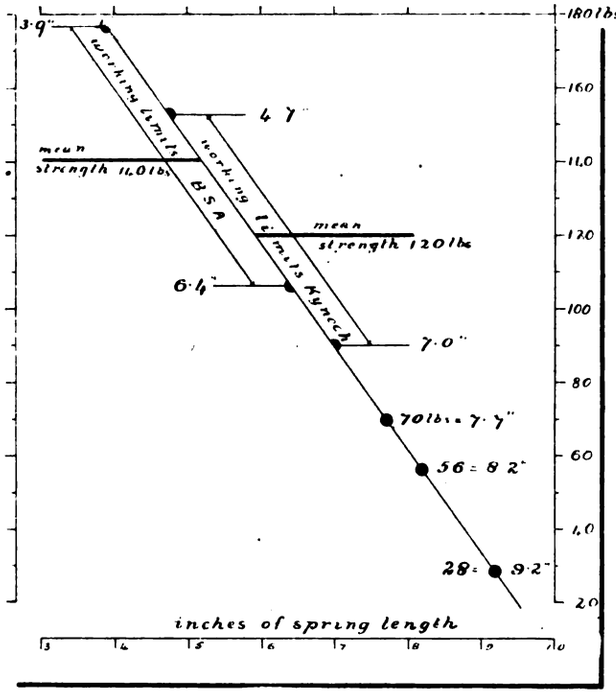
TABLE II.—COMPARISON OF SPRING ENERGY EXERTED.

	KYNOCH	B.S.A.
Length of Spring after discharge (A)	7·0 in.	6·4 in.
,, ,, ,, before ,, (B)	4·7 ,,	3·9 ,,
Distance of Movement (A – B) ..	2·3 ,,	2·5 ,,
Length of Spring Midway (A + B ÷ 2)	5·85 ,,	5·15 ,,
Resulting Average Propulsive Force	120 lbs.	140 lbs.
Comparative Energy	23·46 ft.-lbs.	29·6 ft.-lbs.

The above figures, when compared with the details published in the lecture of November 1906, suggest that the springs present in the air-guns of to-day are on the average more powerful than the ones which were in use about two years ago. It is inadvisable to pursue this point further in the present connection, first, because the actual tests of the springs were not carried beyond 70lbs., and second, because comparative figures only are required.

Taking the items in the Table II. *seriatim* the dimension A is the length to which the spring is compressed when inserting it into the gun. When set ready for firing it is compressed to the dimension marked B. The difference between these two dimensions is the length of stroke already referred to, and their average or midway point is the length of the spring when exerting its average strength between the two extremes. The relation between the length and force of a spring under compression is based upon simple

proportion. Arithmetic is, however, displaced by graphical methods as shown in the accompanying reproduction of the original curve as drawn on squared paper.



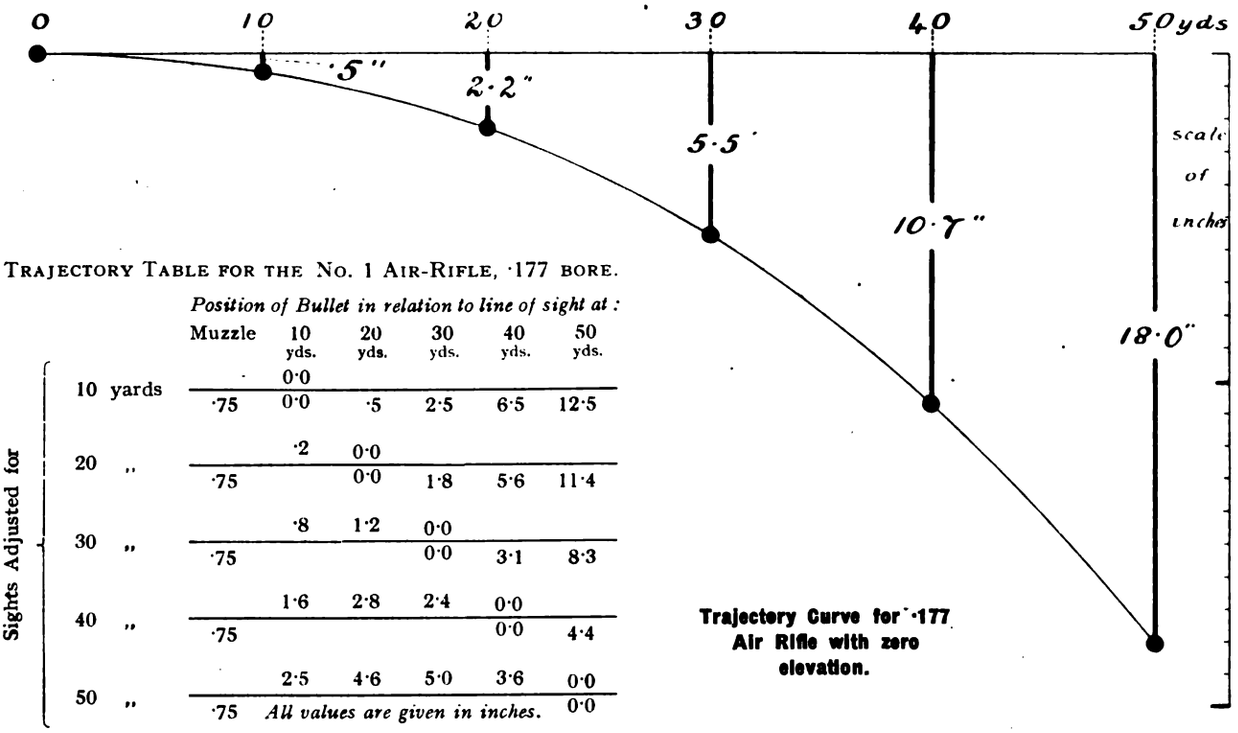
The foot-pounds energy exerted by each spring is found by converting the inches of piston movement into feet, and multiplying by the mean strength of the spring as given in pounds. The result shows that the B.S.A. spring is loaded about 25 per cent. heavier than the Kynoch, but the ultimate result is a lower velocity. From the point of view of comparative dimensions the weight of piston is an important element. That fitted to the B.S.A. rifle weighs 10·8oz., whilst the Kynoch piston weighs 10oz. The lighter piston is thus propelled by the more lightly compressed spring, the heavier piston of the other gun being correspondingly propelled by a spring compressed to a greater pressure.

Taking a general view of the tabulated results, the B.S.A. rifle ought to give the higher velocity. The fact that such difference as there is lies the other way must be ascribed to other causes, and these are obviously connected with the alternative systems of breech closure which distinguish the one rifle from the other. The Kynoch rifle carries out the old principle of a break-down or hinged barrel having special plugs and washers to insure an air-tight junction. The other model carries out the ingenious arrangement devised by Mr. Lincoln Jeffries, the barrel and air chamber being formed in one solid piece, the breech being opened and closed by the rotating plug of the pump air rifles of long ago. There can be no doubt that the rotating breech plug constitutes an effective air cock, and, therefore, that any loss of power which may occur cannot be due to escape of air around the joints of the plug. That a loss of energy, though not necessarily an escape of air, does take place is certain. It may arise from differences of friction between piston and cylinder, or from other similarly indirect mechanical causes. The more probable explanation, however, is that the differences arise solely from the starting friction of the bullet. In the break-down pattern of rifle the bullet is placed in a smooth bore chamber, whence it may be pressed bodily into the rifled portion of the barrel. In the other system the pellet is placed in a kind of ante-chamber in the rotating breech block, and this cavity must necessarily receive the bullet without reducing its diameter, otherwise it would not make a gastight fit with the rifled part of the barrel, into which it afterwards passes. Assuming for instance that the break-down pattern of rifle necessitates the application of a force of 10lbs. to start the slug in movement, and the breech block system a force of 5lbs., then it would follow that the first pellet would be propelled along the barrel by a supply of more highly compressed air than would be available for use by the bullet which had started relatively before the same intensity of air pressure had been established. These matters are unsuitable for treatment by mathematical deduction. Theory certainly shows how it may happen that two air-rifles fitted up in a certain way give an unexpected difference of result, but practical experiment and invention are necessary for securing the most efficient transmission energy from spring to bullet.

Such details as the above require very close examination in connection with the measurement of results and the fixing of a mean trajectory curve striking an average of various bullets and rifles. The rotating breech block has very important advantages, chief among which is the great uniformity of result from round to round. The hinge system of breech gives higher velocity, but the measurements which have been made suggest that it may at times be at the expense of a diminished regularity. Here again practical experience must be left to decide on which side lies the greater balance of advantage. Meanwhile now that the leading characteristics of the two rifles employed in the tests have been made clear particulars may be given of the actual velocity results upon which the above conclusions and others yet to follow are based.

TABLE III.—COMPARISON OF RECORDS OF AIR-RIFLE VELOCITY, BEING THE MEAN OVER 10 YARDS OF VARIOUS SERIES OF ROUNDS.

Particulars of Experiments ...	Match Slug, 9·6 grs.	Witton Slug, 8·0 grs.	B.M.M. Slug, 8·0 grs.
B.S.A. (Lincoln Jeffries) Air Rifle.			
Field Report, 1905 ..	476 f.s.	—	—
Private Tests, April, '08	482 ,,	—	561 f.s.
,, ,, May ,,	564 ,,	648 f.s.	621 ,,
,, ,, ,, ,,	541 ,,	620 ,,	610 ,,
,, ,, June ,,	563 ,,	623 ,,	595 ,,
Kynoch Air Rifle.			
May, 1908	716 f.s.	623 f.s.	—
,, ,, ...	601 ,,	648 ,,	—
,, ,, ...	587 ,,	624 ,,	—
June, ,, ...	741 ,,	676 ,,	693 f.s.



Trajectory Curve for ·177 Air Rifle with zero elevation.

TRAJECTORY TABLE FOR THE No. 1 AIR-RIFLE, ·177 BORE.

Sights Adjusted for	Muzzle	*Position of Bullet in relation to line of sight at:* 10 yds.	20 yds.	30 yds.	40 yds.	50 yds.
10 yards		0·0				
	·75	0·0	·5	2·5	6·5	12·5
20 ,,		·2	0·0			
	·75		0·0	1·8	5·6	11·4
30 ,,		·8	1·2	0·0		
	·75			0·0	3·1	8·3
40 ,,		1·6	2·8	2·4	0·0	
	·75				0·0	4·4
50 ,,		2·5	4·6	5·0	3·6	0·0
	·75	*All values are given in inches.*				0·0

It is difficult at first sight to account for the large differences which at times occur between one set of results and another, using the same rifle and slugs. The rise from 482 f.s. in April to 550 f.s. or therabouts since can only be accounted for by temperature differences. It is well known that highly compressed air attains a considerable temperature and that the escape of this heat causes diminution of pressure. In hot weather the loss due to such escape is much diminished, hence presumably the higher velocity. The temperature explanation does not cover the whole of the differences arising in connection with the Kynoch air-rifle when firing the Match slug. The subject as a whole presents many difficulties, and accurate measurements of velocity, unaffected by outside causes, are difficult to obtain. On the other hand there can be no doubt that the Kynoch rifle gives on the average higher velocity. The results are admittedly, somewhat masked by the varied results shown, the latter in their turn seeming to be influenced to some extent by the method adopted for holding the rifle. The velocity readings seem to have shown a tendency to be higher and more regular with the Kynoch rifle, when the barrel was clasped in a vice, as compared with the alternative method of firing from the shoulder, the rifle resting lightly upon a felt pad situated underneath the joint pin of the action.

Whilst there appears to be very little consistency in the results obtained with the Match slug, the Witton and B.M.M. models show singular uniformity in the neighbourhood of a mean velocity of 620 to 640 f.s. over 10 yards, the results lying outside these limits being obviously exceptions to the general rule. The adoption of the 8-grain slug, whether Witton or B.M.M. make, and the acceptance of the above velocity, which may be converted into the round number of 680 f.s. muzzle velocity, provides a useful basis for examining the results mathematically at some future date.

Some preliminary experiments were made with a view to obtaining a curve of drops by absolute measurements made every 10 yards up to 50 yards. The preliminaries of the test included the re-sighting of the rifle (B.S.A. in this instance) with zero elevation. This resolved itself into twisting around the foresight a piece of iron wire with the tip standing up about an eighth of an inch higher than the ordinary bead. This made the height of the foresight above the centre of the bore about ·9 of an inch. A target consisting of a black edge on a white ground was next prepared, a line being drawn to indicate the distance between foresight and barrel, all as indicated in the accompanying illustration. The backsight was adjusted until, at a dis-

tance of six feet from the muzzle to the target, the bullets exactly cut the line. Without the addition to the foresight the backsight could not have been brought down to zero elevation.

A rifle so sighted was then fired at black-edge targets at 10, 20, 30, 40 and 50 yards respectively. The shooting was concluded at each range when a sufficient number of shots had struck at a consistent elevation to enable the mean drop to be defined. The Match and B.M.M. slugs were fired in comparative series, and the distance beneath the zero line was noted in each instance. The results obtained were singularly consistent, and certain slight alterations resulted in producing a series of drops lying in true curves. The following table shows the results arrived at, the figures in brackets showing where the original readings were afterwards smoothed :—

TABLE IV.—MEASURED DROPS OF MATCH AND B.M.M. SLUGS, USING B.S.A. RIFLE.

	10	20	30	40	50 yds.
Match Slug ..	·2	2·0	5·0	9·3	15·0
	(·0)			(9·0)	
B.M.M. Slug ..	·15	1·8	4·6	8·7	14·2
	(·25)			(9·1)	(14·0)

The above results were subsequently tested with the aid of Bashforth's tables, and it was found that the 10 yards drops were relatively much too small. The rest of the values were fairly consistent in themselves, but not with the measurements of velocity which happened to have been made on a subsequent day. Attention was afterwards concentrated on measuring the drops at 50 yards in conjunction with the taking of velocity, all within the same half-hour. It was found that a further refinement of the adjustment for zero sighting was necessary by way of an allowance of just under the sixteenth part of an inch for the fall of the bullet whilst travelling from the muzzle to the zeroing target situated six feet away. Such an error, though apparently small in itself would be multiplied 25 times at 50 yards, thus amounting to about 1½ inches. The results above given were accordingly used only as a guide to the general shape of the trajectory curve, the following observations of velocity and trajectory being adopted in their place as indicating the true behaviour of the rifles and bullets tried :—

TABLE V.—RECORDS (practically simultaneous) OF VELOCITY AND DROP.

B.S.A. RIFLE.	Match.	Witton.	B.M.M.
Velocity over 10 yards ..	563 f.s.	623 f.s.	595 f.s.
Drop at 50 yards	19·6 in.	18·5 in.	19·4 in.
KYNOCH RIFLE.			
Velocity over 10 yards ..	741 f.s.	676 f.s.	693 f.s.
Drop at 50 yards	17·8 in.	13·0 in.	13·7 in.

Allowing for the reason above given that the drop measurements at 50 yards obtained in the previous experiments should be increased about 1½ inches, there remains a two-inch difference at 50 yards between the two groups of results. This comes very near to the limit of accuracy attainable in tests of this kind. Consequently, a characteristic value of drop can be selected upon which may be built up a trajectory curve covering all conditions. Eighteen inches is the figure which has been chosen, and this, together with the rest of the trajectory curve, is duly set out in the accompanying diagram. So much space having already been devoted to the processes involved in arriving at the curve of trajectory, the reader must take for granted, without further demonstration, the process of deriving therefrom a table of trajectory. The latter deals with rifles sighted for anything between 10 and 50 yards inclusive, the position of the bullet above or below the line of sight, as the case may be, being defined at 10 yard intervals along the range.

THE LATE JOHANNES SELWIG.

Johannes Selwig of Brunswick, the well-known manufacturer of machinery for the Sugar and Explosives Industries, died on the 6th ult., about a year after the death of his partner, Bruno Lange. He was born in 1843 in Brunswick, and attended the Gymnasium and Technical High School, where he evinced great ability for and interest in chemical technology, and in the many improvements which took place in that productive period.

He became associated with the Brunswick Maschinenbau-Anstalt, and was afterwards employed in the leading works at Breslau and Witten on the Rhine. He ultimately became manager of the Halle Maschinenfabrik and Eisengiesserei. In the year 1877, in partnership with Lange, he founded the firm of Selwig and Lange in Brunswick. The young firm began an energetic career—Selwig being the capable constructor and inventor, and Lange the clever man of business. Important inventions and improvements in machinery were made at first in the field of the Sugar Industry, and their Centrifugals, Filter Presses, Osmose apparatus, etc., soon brought the firm a world-wide reputation.

When smokeless powders were introduced at the end of 1880, Selwig devoted himself to this branch of industry. He invented the Nitrating Centrifugal, with cooling and heating arrangements, which was immediately introduced into the Government and private factories of Germany and other countries. By means of the Nitrating Centrifugal the manufacturer was able to produce nitro-cellulose cleanly and without danger. Further important improvements were the Nitrating Centrifugal with acid circulation, and the hydraulic guncotton conveyor. He also made centrifugals for acid guncotton, and a great variety of plant for use in the production of guncotton and smokeless powder.

Selwig was eminently inventive, genial, enterprising and hard-working, and his candid nature and pleasing personality made him generally highly esteemed. For many years he was a member of the Brunswick Parliament, in which he took a keen and active interest. The firm is being continued under the old name of Selwig and Lange.

INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY. Mr. William Macnab, F.I.C., in his capacity of honorary secretary of the Seventh International Congress of Applied Chemistry, has sent out the following circular from his laboratory, 10 Cromwell Crescent, S.W.

"The Seventh International Congress of applied Chemistry will be held in London, from May 27th to June 2nd, 1909. An organising Committee has been formed for the purpose of making all arrangements for the holding of the Congress in London. This Committee consists of representatives of the following Societies :—

Royal Societies of London, Edinburgh and Dublin, Society of Chemical Industry, Chemical Society, Institute of Chemistry, Society of Public Analysts, Royal Society of Arts, Iron and Steel Institute, Institution of Mining Engineers, Institution of Mining and Metallurgy, Society of Dyers and Colourists, International Association of Leather Chemists, Institute of Brewing, Royal Agricultural Society of England, The Lawes Agricultural Trust, Pharmaceutical Society, Royal Photographic Society, Faraday Society, London Chamber of Commerce

(Chemical Trade Section), representing all the most important industries.

Previous Congresses have been held in Brussels (1894), Paris (1896), Vienna (1898), Paris (1900), Berlin (1903), and Rome (1906). The work of the Congress has steadily grown in importance, and it is hoped that the London Congress may be a worthy successor to those which have gone before."

Then follows a list of sections from which it appears, amongst others, that Sir Andrew Noble is president of the Explosives sub-section of metallurgy and mining. Mr. Macnab expresses willingness to give any explanations which may be desired.

THE PIEPER AUTOMATIC PISTOL.

M. Nicolas Pieper, gunmaker, of 42, Rue Bonne-Nouvelle, Liége, has asked us to publish a notice of the pocket automatic pistol which he is advertising in the business columns of this journal. The request that a sample of the pistol should be sent with a view to examination and report having been duly complied with, it is possible now to state that the weapon has been shot and tested, the automatic mechanism having satisfactorily performed its function on all occasions. The cartridge for which the weapon has been constructed is the 6·35 mm. Browning, which is the metric way of saying ·2499995 of an inch. In other words the cartridge is of ·250 calibre, having been introduced by Mr. Browning of America who obviously thinks in inches, but converts them into metrics when dealing with Continental factories. The bullet measures exactly ·250 in diameter, and as it cannot be forced down the barrel the true bore of the pistol, measuring from land to land of the rifling, is about ·240in. The weight of the bullet is 50 grains, being propelled by about 1½grains of an irregularly chopped leaflet smokeless powder. The Fabrique Nationale were the original issuers of the cartridge, but it is now made by other firms, including Messrs. Eley Bros. Being specially designed throughout for use in automatic pistols, it has become a standard type of ammunition for the very small pocket size of these weapons.

The outstanding feature of the Pieper pistol, which distinguishes it from almost all other models of automatic arms, is that the barrel hinges on a pivot, and can be swung out, in the manner illustrated in the advertisement, entirely independently of the working of the automatic mechanism which lies to the rear. Although small pistols of this description are almost habitually neglected as regards proper cleaning of the barrel, the fact remains that an alteration of mechanism, which makes it easy to preserve the bore in first-class order, will be appreciated by all shooters. Safety conditions are duly observed by an automatic catch which prevents the firing of the pistol unless the barrel is properly held down in place. The harmonising of a drop-down barrel with automatic loading necessarily involves a connection between barrel and breech, so that the two may recoil together in the well-known fashion. The junction, though seemingly contrary to the drop-down system of breech, is effected by a particularly ingeniously planned self-locking link and the practical test which it has received shows that it works satisfactorily. The possibility of premature discharge in the pocket is obviated in two ways; first, by the provision of a safety catch, which is set by the thumb when it is desired to lock the mechanism, and second, by making the trigger with an extra heavy pull.

The pistol weighs about 13½oz., which is roughly speaking the same as the Browning of the same calibre. The length from muzzle to back of breech is five inches, whilst the height from the bottom of the grip to the top of the action is inside 3½inches. Consequently the pistol amply justifies the claim to be considered a pocket weapon. *M.* Nicolas Pieper is to be congratulated, not only upon the neat and workmanlike pistol which he has turned out, but also on the descriptive catalogue he has issued. It contains a number of well prepared illustrations, the particulars and instructions being conveyed in a variety of languages which should render the meaning intelligible to the bulk of the civilised inhabitants of the globe.

APPLICATIONS FOR PATENTS.

MAY 25—JUNE 20, 1908.

11,295.* Armour-piercing Projectiles. P. M. Justice.
11,319.* Securing Gun Locks. H. W. Holland and T. Woodward.
11,326.* Firearms. A. Woosnam.
11,366. Orthoptic Sight Attachment. R. W. Glanville and C. F. H. Bayley.
11,381. Range Finder. R. Rodger.
11,807. Explosives. H. Y. Glen.
11,809. Rifle Sights. London Small Arms Co., Ld., F. W. Bennett, and C. S. Bayley.
11,812. Explosives. H. Y. Glen.
11,893. Moving Targets. E. J. Solano.
11,981.* Firearms. P. Mauser.
11,999.* Self-Propelling Projectiles. W. T. Unge.
12,187. Magazine for Small Arms. H. F. Landstad.
12,188.* Explosives. Anglo-French F. and S. Ld., and Sir J. B. Edwards.
12,231.* Barrel Recoil Guns. H. Lehmann.
12,606. Ejecting Mechanism. F. Rogers and F. G. Rogers.
12,732.* High Explosives as Propellants. G. Barker.
12,762.* Telescopic Sights. C. Zeiss.
12,778.* Travelling Ordnance. Fried Krupp.
12,779.* Wheeled Gun Carriages. Fried Krupp.
12,791. Range Finders. G. Forbes.
12,843.* Preventing Gun Erosion. B. C. Winslow.
12,851.* Ammunition Rammers. Fried Krupp.
12,953.* Quick-Firing Gun. P. Gargalidis and G. Conteas.
12,958.* Ordnance Ramming Mechanism. E. Schneider.
12,963.* Range Finders. A. J. Boult.
13,085.* Directing Gun Fire. L. K. Scott.
13,170. Bolt Action Rifles. B.S.A. Co., Ld., A. H. M. Driver, and G. Norman.
13,180.* Transport Vehicles for Guns. Fried Krupp.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

MAY 28—JUNE 18, 1908.

COMPILED BY HENRY TARRANT.

4,588 (1907). **Ammunition Hoisting Apparatus.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. In this bulky specification improvements are described in ammunition hoisting apparatus for heavy turret ordnance. In a three gun turret mounting the ammunition is raised to the working chamber by three independent hoisting cages. Each of the cages is adapted to deliver its load

automatically into the receptacles in the working chamber. Continuity and rapidity of supply are aimed at. Accepted May 25, 1908.

6,539 (1907). **Ordnance Sighting Gear.** Lieut.-Col. L. K. Scott, C.B., Farnborough. The adaptation of the automatic sighting apparatus. (Patent No. 7,584, 1898) for field guns and the employment of various improvements in the mechanical method of application of this apparatus to field guns (Patents Nos. 25,585, 1901, 5,501, 1903, 20,203, 1904), is dealt with in the present specification. Corrections for unlevel platform and drift are provided for. Accepted May 18, 1908.

10,149 (1907). **Automatic Fire-arm.** The Hotchkiss Ordnance Co., Ld., London. (Agents for *L. V. Benét, and H. A. Mercié, Paris*). An automatic firearm whose mechanism is operated by the gases which escape through a hole in the barrel and push back a piston. Through cam surfaces the piston is caused to revolve the breech block and throw this part back which is otherwise locked against longitudinal movement. Accepted May 1, 1908.

10,276 (1907). **Telescope Attachment for Rifles.** T. W. F. Rowney, Derby. To facilitate " spotting " the telescope is attached by simple means to the side of the rifle (a Martini is illustrated) so that by moving his head slightly to one side the shooter may readily observe where his shot has struck the target. The axis of the telescope is adjusted so that it meets the line of sight at the target. Accepted May 4, 1908.

10,567 (1907). **Detachable Lock Plates for Drop-down Small Arms.** J. Deeley and L. B. Taylor, Birmingham. The detachable lock plate and combined mechanism dealt with in Patent No. 17,731, 1898 is improved. The bent is made at the top of the hammer at the greatest available radius from the pivot, and a bell crank shaped sear is employed the end of the vertical arm of which engages the bent. The point at which the main spring pressure is applied is altered and a checkered part is provided to facilitate the cocking of the hammer when the lock is detached. Accepted May 7, 1908.

10,622 (1907). **Machine Gun Cartridge Feed.** Capt. A. B. Carey, R.E., Hythe. A number of cartridge holders similar to the clips used to load the magazines of small arms, are attached by their bases to the outside of a rotatable cylinder. When a clip has been emptied (the cartridges being fed from the clip to the barrel by a spring pressed arm) the drum is automatically revolved by a spring which has stored up some of the energy of recoil of the past clip load of ammunition. Accepted May 7, 1908.

11,157 (1907). **Aiming Apparatus.** F. W. Moffat, Tidworth. By an arrangement of cords any deflection of the line of sight from the distant target is communicated in an exaggerated degree to the end of a pointer or pricker which is caused to pierce a small target when the trigger is pulled so as to indicate the position of the hit had a cartridge been fired. Accepted May 13, 1908.

11,370 (1907). **Cartridge Belt Pockets.** Major M. C. Maunsell, London. A pocket for belts is constructed to hold two or three clip loads of rifle cartridges. Between each full clip a strip of flexible material is arranged. The inner end of the strip is secured at the bottom of the pocket whilst the outer end protrudes and may be fastened by means of a button. Accepted May 15, 1908.

11,612 (1907). **Howitzer Sighting Apparatus.** Lieut. A. T. Dawson, and G. T. Buckham, London. The sight is mounted on a bracket carried by a loose ring situated on the left hand trunnion of the cradle, and the bracket is free to train to right or left about a pivot pin on the loose ring. The bracket is connected to the casing of the recoil buffer by a link which transmits the training movement to a sliding block working in a curved slot in the bracket. Accepted May 14, 1908.

12,631 (1907). **Machine Gun Firing Mechanism.** Lieut. A. T. Dawson, and G. T. Buckham, London. Automatic guns of rifle calibre pattern are provided by the patentees with " change fire gear " for enabling the gun to fire single shots or to fire automatically or to be set at safety. The trigger mechanism is constructed to adapt it for this purpose. Accepted May 28, 1908.

13,562 (1907). **Range Finders.** H. D. Taylor, York. The improvement of optical squares or double reflecting contrivances such as are used in range finders is dealt in this patent. The introduction of exactitude in the manufacture of the two plane glass mirror reflectors, and the method of fixing them to frames of specially selected metal are fully described. Accepted May 14, 1908.

14,669 (1907). **Combination Fuses for Projectiles.** Lieut. Z. Michaelides, Greece, and G. H. Parker, Lancaster. A worm drum having a portion cut away is revolved by a vane situated on the nose of the fuse. The vane is rotated as the projectile moves through the air. When the cut away portion of the threaded drum is turned sufficiently to bring it opposite the projection which holds it the hammer is released to strike the cap. Accepted May 28, 1908.

14,718 (1907). **Ordnance Sighting Gear.** Sir W. G. Armstrong, Whitworth and Co., Ld., and C. H. Murray, Newcastle-on-Tyne. Means have been described in Patents Nos. 3,126, 1906 and 12,961, 1907 for automatically compensating loss of muzzle velocity or wear of gun. Means are now introduced whereby a single cam piece may be employed without reversal for positions on either side of the normal. Accepted May 7, 1908.

17,910 (1907). **A Metallic Fouling Remover.** The King's Norton Metal Co., Ld., T. A. Bayliss, London, H. M. Smith, Abbey Wood, and H. W. Brownsdon, London. (*See Selected Patents*).

20,006 (1907). **Automatic Pistol Mechanism.** A. W. Schwarzlose, Germany. The " grip " design of safety mechanism which has been applied to small-arms of various types is now applied to the automatic pistol which has a forwardly sliding barrel. When the shooter grips the butt the main spring is tensioned and the lock is removed from the trigger. Accepted May 28, 1908.

21,502 (1907). **Dummy Cartridge Cases.** H. W. Blanch and C. W. Andrews, London. A flat blank of tinned plate is stamped to form two attached parts each of which corresponds in shape with half of the cartridge case and bullet divided longitudinally. These two parts are formed over so as to resemble the complete cartridge. The base is covered by a cap or disc. Accepted May 21, 1908.

23,188 (1907). **Back Sight for Rifles.** J. Y. Bassell and J. C. Blenkner, U.S.A., This slide for the tangent leaf of a rifle backsight is provided with a locking screw to clamp it at any elevation, and a rotatable disc carrying a number of apertures of varying sizes which may be used as an alternate to the ordinary notches. The guideway of the tangent leaf is cut so as to automatically compensate for drift when the slide is moved up the leaf. Accepted May 28, 1908.

27,297 (1907). **Back Sights for Rifles.** P. Jensen, London. (Agent for *The Lyman Gun Sight Co., U.S.A.*) A back sight for rifles is provided with a sight leaf which is elevated to the required position and is clamped in that position by a wedging action through a screw part. Accepted May 7, 1908.

27,888 (1907). **Ordnance Breech Mechanism.** Fried Krupp, A.-G., Germany. This patent relates to improvements in the type of ordnance breech mechanism the opening movements of which are composed of an operation directed transversely to the longitudinal axis of the gun barrel and a swinging movement. Accepted May 21, 1908.

28,500 (1907). **Saddles for Machine Gun Mountings.** A. J. Boult, London. (Agent for *Deutsche Waffen-und, Mf., Germany*). The saddle is divided down the middle so that it may serve as a seat or as an arm rest when the mounting is in the elevated or depressed positions respectively. Accepted May 21, 1908.

869 (1908). **Ordnance Sighting Attachments.** Fried Krupp, A.-G., Germany. The sighting attachment with curved bar for ordnance with horizontal trunnions near the breech of the gun is construced so that it may lie over the trunnion which carries it and the sighting line yet have a normal level at every barrel elevation. Accepted May 21, 1908.

1,819 (1908). **Priming Composition.** F. Hyronimus, France. The patentee states that trinitrate of lead $(N_3)_2Pb$ gives similar results to fulminate of mercury, and is cheaper and

more easily and safely prepared. The manufacture consists in the precipitation of the trinitrate of lead through a double decomposition from a solution of trinitrate of sodium with a solution of nitrate of lead. Accepted May 21, 1908.

2,420 (1908). **Drop Targets.** Major J. Krcek, Austria. A hollow target is filled with a clay solution—a pasty mass adapted to fill up the shot holes and prevent escape of the whole of the solution. The action of the bullet on this mass operates an elastic part and brings about an automatic release of target so that it drops when struck. Accepted May 21, 1908.

2,917 (1908). **Automatic Pistol Magazine Mechanism.** P. Mauser, Germany. The detachable magazine holds the breech open in the usual way after the discharge of the last cartridge but as it is withdrawn to allow a loaded one to be inserted it is caused to operate the ejector spring through a detent so that the spring is projected into the path of the breech bolt to hold the pistol open. The insertion of the loaded magazine removes the obstruction so that the pistol may automatically close and load. Accepted May 28, 1908.

2,929 (1908). **Shrapnel Shell.** Major-Gen. R. Wille, Germany. The projectiles of a shrapnel are shaped similar to a small-arm bullet and are built up one on top of another in a series of rifled tubes parallel with the axis of the shell. Flatter trajectory and a greater beaten zone are claimed. Accepted May 21, 1908.

3,526 (1908). **Range Finder.** C. Zeiss, Germany. Improvements in stereoscopic telemeters are described. In the same part of the stereoscopic field of view in which the measuring mark is seen, but not at the same apparent distance auxiliary marks are made visible. By means of these and the travelling mark the accuracy of the instrument is enhanced. Accepted May 21, 1908.

4,245 (1908). **Ejector Mechanism for Drop-down Small-arms.** H. White, London, and N. Dryden, Harrow. (*See Selected Patents.*)

4,614 (1908). **Automatic Small Arm Mechanism.** P. Mauser, Germany. In order to allow of the manipulation of the handleless breech bolt of this automatic rifle a cavity is provided in the bolt head into which the cartridge base may be inserted so that the bolt may be drawn rearwards by hand. Accepted May 21, 1908.

5,141 (1908). **Automatic Fire-arms.** The Hotchkiss Ordnance Co., Ld., London. (Agents for *L. V. Benét and H. V. Mercié, Paris*). In the cartridge feed mechanism the feed piece is capable of a compound movement for locking or unlocking the piston (by which the breech bolt is operated) and for automatically advancing the feed strip containing the cartridges. Accepted May 1, 1908.

5,142 (1908). **Automatic Fire-arms.** The Hotchkiss Ordnance Co., Ld., London. (Agents for *L. V. Benét and H. A. Mercié, Paris*). In the firing mechanism of this machine gun a part is introduced which by different movements sets the gun at " safe," or for single shots or automatic firing and allows for cocking the mechanism by hand. Accepted May 1, 1908.

SELECTED PATENTS.

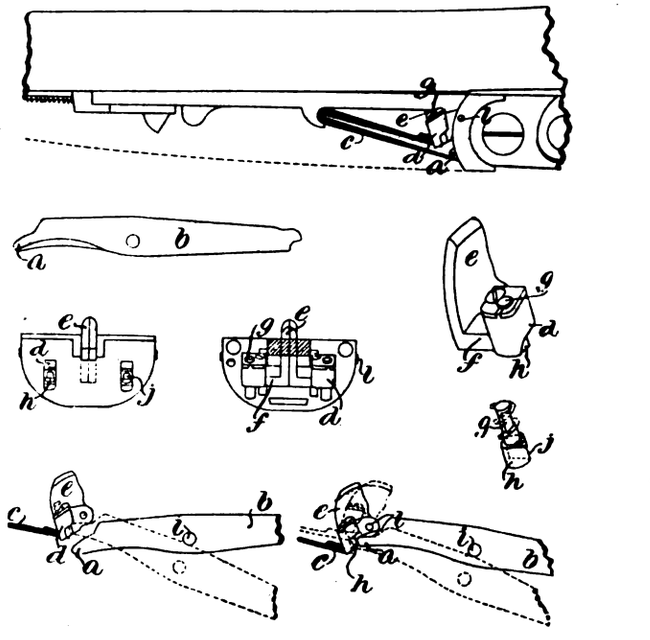
A PASTE FOR REMOVING METALLIC FOULING IN GUN BARRELS.

17,910 (1907). King's Norton Metal Co., Ld., T. A. Bayliss, London, H. M. Smith, Abbey Wood, and H. W. Brownsdon, London. A paste formed of vaseline and a salt or compound of mercury is applied to the interior of gun or rifle barrels in order to form a soft amalgam with the metallic fouling therein, so that the latter may be the more readily removed. The composition has, besides, a lubricating qualification.

The paste is made up of one part by weight of mercury with two parts of vaseline, and is ground up with the vaseline until it has lost its bright lustre, and becomes a soft greyish tinted mass. Oxide of mercury is selected as the salt of this metal, preferably precipitated mercurous oxide. The same proportions are used as when mercury, not a salt is employed. Before adding the mercury or its salt to the vaseline this lubricant may be mixed with a small percentage of caustic soda. An alkaline character is by this process imparted to the compound. Or a small proportion of potassium or sodium may be used to impart to the lubricant left on the surface of the barrel an alkaline nature. In this case amalgam of sodium or potassium (one part) is made with the mercury or its salt (100 parts) before admixture with the vaseline. Accepted May 14, 1908.

EJECTOR MECHANISM FOR DROP-DOWN SMALL-ARMS.

4,245 (1908). H. White (J. Lang & Son, Ld.), London, and N. Dryden, Harrow. The ejecting mechanism described in this specification is actuated at the correct moment by the toe of the ordinary cocking lever used in practically every break-down arm of the shot gun type. An extra limb such as the detant, tripper or lug associated with most ejector mechanism is not utilized.



The patent drawings reproduced in the body of this short description clearly illustrate the arrangement of the ejector hammers and their side extensions through which the end *a* of the cocking lever *b* communicates sufficient push when the gun is broken down after firing to turn the ejector hammer over a dead centre and allow the ejector spring *c* to drive it forward to administer a smart tap to the end extractor leg and so " flick " the spent cartridge from the barrel.

The side extensions *d* or " bosses " form part of the ejector hammers *e* and the ejector springs *c* act on the connecting bridges *f* in the known manner. To prevent the ejector hammers being actuated when the gun is opened before it has been fired or the hammers released the bosses *d* are provided with spring actuated plungers *g*. If the gun is opened before firing the nose *a* of the lever comes into contact with the end *h* of this plunger and merely operates that part without moving the ejector hammer, although the extractors are pushed out as usual. When, however, the gun is fired the cocking levers are turned on their pivots *i* so that the noses are raised and are receded slightly from the ejector hammers. When the gun is opened after firing the noses *a* of the levers bear against the faces *j* of the plungers and are compelled to force the ejector hammers round on their pivots *l*, so that the springs *c* operate to eject the empty cartridge shells.

Each barrel has as usual its own set of mechanism so that if one barrel only is fired the empty case is ejected and the loaded cartridge in the other barrel is in the ordinary way only extracted slightly out of the barrel. Accepted May 28, 1908.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 191.—Vol. XVI. AUGUST, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

Clay Bird Shooting at Uxendon.—The two clay bird shooting meetings which took place last month at Uxendon, the Olympic and Championship respectively, confirm in the most emphatic manner the opinions which were expressed in last month's issue concerning the need for a thorough revision of the existing code of rules. Against the probability of such a thing happening is that the power of action rests with the existing shooters who have accustomed themselves to the present organisation and would resist change from motives of conservatism. At Uxendon the heavily timbered background and the existence of a draughty wind-swept gully, combined with birds deliberately rendered exceptionally difficult, strikingly to reduce the averages of all moderate shots, and to throw the prizes into the hands of the few who were gifted with lightning rapidity of action. Had the shooters been allowed to use a single barrel, firing a cartridge containing a charge capable of dealing with a clay bird at a full range, complaints would have been less rife, but as it happened the foreign Olympic competitor found himself at a meeting where a severe restriction of load was enforced, whilst the birds were thrown in a way that could only be justified on the assumption that shooters were to be allowed the use of duck guns. The problem presented to those in search of suitable cartridges complying with the 1⅛oz. rule is hedged with difficulties. Pattern is essential, but can only be obtained of the required density by lowering velocity, and using a small size of pellet. Yet a certain amount of striking power is essential to ensure breaking a tough clay bird when struck on the highly bevelled edge presented to the shooter. To specialise on one side or the other spells failure, and there is no room for the happy mean. Satisfactory cartridges can never be produced unless there is a sufficient margin to cover lapses from theoretical perfection, and it is quite certain that the sporting enjoyment of clay bird shooting is greatly restricted by the necessity to use an inefficient cartridge, whose various items of specification are balanced on the edge of nothing.

The Zeroing of Military Rifles.—One of the most difficult, most elusive, and most unstable problems of the rifle is that which concerns the ascertainment of the zero angle. As the basis of accurate target shooting it should be tangible and exact. Yet its definition is of an abstract nature, so that to the practical shooter it seldom ranks as more than a vague mental picture. Just as much as there is no means of measuring the muzzle velocity of a cartridge, so there is no means of directly ascertaining zero elevation. The zero, like the velocity, can be measured over ten yards or 60 yards, or any other distance, but the true zero, like true muzzle velocity, is based upon a calculation which assumes certain properties of the bullet. Zeros taken over a short distance give very close approximations to what is wanted, but certain sources of error are at a maximum when the distance is short, and this brings into prominence one of the

great defects of zero shooting. When the gunmaker sights a sporting rifle, he adjusts the sights at the distances over which the rifle is likely to be used, and the only serious error to be avoided is the risk that the rest used for steadying the aim may falsify the adjustment of the sights. The soldier's rifle, being intended for shooting at all ranges within the possible flight of the bullet, should presumably be zeroed at a selected average distance such as 500 or 600 yards; but instead of this 33⅓ yards is the distance in vogue, and although practical conditions should be observed, manufacturing necessity ordains that rifles shall be fired from a piece of machinery which aims at reproducing the physical effects of shoulder shooting. The body of officers and experts responsible for the supervision of this branch of the activities of the Enfield factory are keen experimentalists, and their efforts are ever directed towards placing in the soldier's hands a weapon whose sight graduations are from a service point of view true. Extraordinary care is taken to strike a happy mean, but some of the sources of error are exceedingly complex and remote. The latest researches suggest the necessity to adopt the 500 yards angle as the basis of a rifle's shooting, rather than that derived from the more convenient short-range test at cardboard targets. Important as are these enquiries into points of detail it must not be forgotten that a stable breech action and a high-power cartridge are the prime necessities of the moment, whose importance must be urged whenever the opportunity occurs.

The Status of Rifle Clubs.—The Duke of Connaught in his speech to the members of the miniature rifle clubs, who had gained success in the Queen's Cup Annual competition amongst representatives of counties, emphasised the importance of the association of clubs with the counties in which their respective head-quarters are situated. Mr. Haldane, in presenting the prizes at the Bisley Meeting, worked upon the same theme, and these are but two amongst many other evidences of a desire to associate the rifle club movement with the new scheme of a territorial organisation. The successful admixture of the civilian and military element for the purposes of rifle shooting practice depends very largely upon the tact and care which are exercised in safeguarding the sporting element in the competitions. So long in fact as rifle shooting can be developed upon lines which render it an enjoyable pastime it will not lack enthusiastic votaries willing to spend money as well as time in developing a high grade of skill. Any attempt on the other hand to lay down a particular programme of practice, or otherwise to import into club rifle shooting the military theories of the moment, might result in a loss of interest amongst the members. The unfavourable reception which was accorded to the War Office circular condemning Bisley methods of shooting made it known in influential quarters that a voluntary movement must be allowed to develop on its own lines, even if those lines are theoretically not the best. The Bisley shooter, with his personal interest and specialised skill, will always be a better shot than the regular soldier whose other duties and preoccupations must receive equal attention. This precedence of the volunteer as a marksman would be even more pronounced than at present if the army did not keep in training at Hythe a special body of rifle shooting experts, whose business it is to represent the regular forces in public rifle shooting competitions. The rifle clubs, and especially those which practice at miniature ranges, must be allowed to develop skill on the lines which please them best. The respect for domestic liberty which governs the policy of the National Rifle Association towards its minor satellites, must never be disturbed. If the War Office authorities appreciate the necessity to confine reforming zeal to the regular army, their closer association with rifle clubs by way of free grants of ranges and ammunition would doubtless be highly appreciated.

Our Lecture on Air-Rifle Ballistics.—It is truly surprising to find that the accuracy of the air-rifle observations which were recorded in the lecture of a month ago, have been so closely confirmed by subsequent mathematical analysis of the results. So curiously confirmative were the two methods of examination that it was found at a certain stage of the calculations that a difference of behaviour between the Match and the Witton bullets could only be accounted for on the assumption that the former had a more perfectly rounded shape of nose than the latter. This, upon examination, proved to be so, and it may accordingly be accepted as a proved fact that the Match bullet has a more favourable value of n than the Witton, but that both shapes set up about twice the amount of air resistance that one regards as standard. The Paradox bullet provides an interesting parallel case, where low density was supposed to necessitate an unfavourable contour from a ballistic point of view. When the shape was improved by the adoption of an air-spaced nose having the required smooth exterior shape, a marked gain in flatness of trajectory and accuracy of flight was at once registered. The market may demand that air-rifle bullets should be cheap, and considered as cartridges they are absurdly cheap; but on the other hand shooters would cheerfully pay a price which would compensate the manufacturer for additional trouble if he could produce an air-rifle slug capable of reducing the effects of air resistance by one half. The range of these weapons is at present somewhat restricted, and mechanical improvements have practically ceased since Mr. Lincoln Jeffries pioneered the modern air-rifle. The late Mr. Housman made a small but brilliantly successful discovery concerning the shape of bullet best adapted for propulsion along the bore of rifled air-guns. In his day there was no need to carry the improvement to its logical conclusion by smoothing down the awkward front of the spool-shaped bullet. With pointed bullets to suggest how the present form of nose may be improved without unduly adding to weight, it is possible that the time is ripe for fresh developments. If the advantages gained are really substantial the doubling, or even the quadrupling, of price would not bar the immediate success of a new design. For whatever the fact is worth the latest lecture to young gunmakers informs the reader that the best air-rifle slug of to-day sets up twice as much resistance as seems necessary.

THE BISLEY MEETING.

THE forty-ninth annual rifle shooting meeting of the National Rifle Association, which has just been completed, provides valuable material for reflection on the part of those who are anxious to anticipate the future. The Military service rifle has been fired under conditions allowing in the matter of sighting a latitude such as has never before been countenanced. The natural result has been a vast assortment of designs, many of the most popular tending in the direction of bringing the lately sanctioned aperture by fair means or by foul as near as possible to the eye. It is safe to predict that the present state of chaos will continue until the aperture is allowed to be brought back to a proper distance from the eye. In the ordinary way one would expect that so radical a departure from existing methods of sighting would necessitate alterations in the machining of the body of the rifle, but, situated in exactly the right position are the screw holes of the existing aperture rear sight which is intended for use at extreme ranges in combination with the dial foresight. The word has only to go forth that next year's sights may be fitted to the existing aperture base in order that designs of a practical and utilitarian kind may at once be forthcoming. It cannot be supposed that permission will be withheld in regard to so obvious and so beneficial a step in the direction of progress.

The defects of the service ammunition are painfully apparent now that the Bisley ranges so frequently display two entirely different grades of shooting, the inferior grade being prevalent when service ammunition is used, and the superior, when private enterprise is allowed to cater for the needs of the service rifle shooter whilst engaged in an important team contest. One knows in a general kind of way that Enfield is making experiments, but unfortunately, whether it be for financial and other reasons the machinery of reform is difficult to set in motion. Rifle shooting with the service weapon needs just the filip it would receive from the concurrent adoption of M.D. Cordite and a pointed bullet. It must not be forgotten when speaking of this explosive that better results are as a rule obtained from powders having five-per-cent. more nitroglycerine than the M.D. specification allows. Judging by private experience such a change introduces no complication, and its benefits are unquestionable. So long as the bullet is pointed it is immaterial, at any rate for a time, whether or not it is reduced in weight to give increased velocity. The all important requirement is the sharp point, and the benefits of its introduction would outweigh any slight complication which might arise from the alteration of angle for each range of shooting.

As regards sporting rifle events great credit is due to Mr. W. R. Leeson for having initiated a double-shot contest at the running deer, which thus becomes essentially a competition where the double rifle acquires prominence. Mr. Walter Winans was the most energetic shooter in this event, but Capt. Ranken's score of 27 heads the list. In the Olympic Games contest these two shooters firing under the same conditions tied for the first place, and Mr. Winans was successful in the shoot off which followed. So sporting are the conditions that it may be hoped that a competition on the same lines will become a permanent feature of the Bisley Meetings of the future. The stimulation of effort amongst makers of double-barrel rifles will provide a valuable aid to progress. The two barrels must be correctly set to throw in true line, and the ammunition should combine extreme accuracy with very high velocity and low recoil. In other words the latest type of rifle cartridge must be used.

On the revolver ranges the lessons of the Olympic programme have already produced their result, in so far that the Webley and Scott Company had a dozen pistols available for use by competitors in an event set down in the programme for miniature pistols. The quality of the shooting produced, especially during the Olympic meeting when the range was 50 yards, suggests that this new branch of rifle club activity may achieve considerable popularity. The manufacturer needs encouraging before he can undertake to turn out ·22-bore pistols on a manufacturing scale. The chief need of the moment is a definition of what actually constitutes a pistol, for the Belgians, who were second in the team match at 50 metres, used a weapon which resembled more closely than anything else a rifle with the stock removed and a hand grip added beneath the balancing centre. Pistols may need a certain amount of specialisation, but the limits should be defined to exclude absurdities and secure equal conditions for all competitors.

The question of match rifles and match rifle cartridges has been left till last, because had it been dealt with first the whole available space would have been occupied. The sensational introduction of the Ross ·280-bore rifle is difficult to describe whilst observing a due sense of proportion. To distinguish personal skill from qualities due to the rifle and ammunition, and to know exactly what value to give to the quality of the barrel and workmanship generally put into the stock and action, is to risk an opinion on matters which can only be settled in the light of more experience than is at present available. On scientific grounds there is undoubtedly an advantage in a reduction of calibre from the prevalent ·303. Other advantages follow from the employment of a large capacity cartridge, and so on and so forth, all ending in the conclusion that match rifle shooters are determined to give the new conditions a thorough trial next year. A Mauser rifle of seven millimetres, otherwise ·276 inch, chambered for a ·375–·303 cartridge necked down to the required size of mouth will reproduce most of the essential characteristics of the Ross ·280 bore. This change and search for novelty is all in the right direction, so long as manufacturers have reasonable notice of what next year's requirements are likely to be. From the point of view of elucidating military problems the adoption of ·280 calibre forecasts the probable development of military rifles. The best shape of bullet, combined with the best weight for giving flatness of trajectory over the most extended ranges, cannot be realised in ·303 calibre, except at the cost of undue recoil. The ·280 bore lends itself to a harmonious blending of shape and weight in the bullet and low recoil in the rifle, and even if the match rifleman experiments with the heavy bullets which give the best target results his labour will be by no means wasted.

LECTURES TO YOUNG GUNMAKERS.

LII.—THE BALLISTICS OF AIR-RIFLE BULLETS.

Written with the Collaboration of Mr. F. W. Jones.

THE experimental results which were given in the last lecture provide an excellent basis for the study on scientific lines of the behaviour of air-rifle bullets. It will be remembered that careful measurements were made of the drop at various ranges of different kinds of bullets fired from two kinds of rifle. An average result was ultimately selected, and from this basis a trajectory table for use by shooters was drawn up. The details of simultaneously measured velocity and drop furnish excellent material for investigating the ballistic coefficient of air-rifle bullets, so demonstrating one of the most interesting aspects of shooting experiments, viz., their relation with calculations of trajectory. The methods which it is proposed to use in the present lecture can be applied to any other kind of rifle and cartridge.

The most convenient, and at the same time the most absolute, index of the trajectory of air-rifle bullets was found to consist in first sighting the rifle with zero elevation and then to shoot at 50 yards, using a target large enough to receive bullets with a drop amounting to a couple of feet. A rifle has zero adjustment of the sights when the axis of the bore at the moment when the shot leaves the barrel, is parallel to the line of sight taken. With zero sighting the bullet strikes as much below the point of aim as the barrel is below the front sight, plus, be it remembered, the drop due to the action of gravity over the range used. To be pedantically exact it should be noted that the above definition takes no account of "jump," which may exercise a disturbing effect not easily measured. Supposing, for instance, that in the act of firing a gun jumped bodily and in a parallel fashion the hundredth of an inch out of its first position. This jump would affect the position of the bullet on the target the hundredth of an inch, whether the target was ten feet or a hundred feet distant. When fixing the zero sighting of a rifle at very near ranges it is necessary to remember that the existence of jump may lead to the adoption of a false adjustment which may mask the measurements of drop subsequently made. When the distance is increased the errors of false measurement are diminished, but the drop due to gravity becomes increasingly important. With the service rifle, for instance, the zero elevation is usually settled by shooting at 10 yards. The added elevation for any given distance being well known, the shooter can adjust his sights so as to ensure hitting the target. On the other hand, for observations of an extremely accurate nature it is desirable to shoot the rifle at such some distance as 50, 100 or 200 yards, and to arrive at the zero by deducting the known drop over those ranges. Very exact values can, if necessary, be obtained by shooting the rifle over the distance used for measuring velocity. No definite rule can be laid down to govern all conditions, and considerable judgment must be exercised in selecting the best distance to zero a rifle, having due regard to the particular kind of experiment which has to be made.

The air-rifles, whose behaviour was reported in the last lecture, were zero sighted at a target situated six feet from the muzzle. The height of the foresight above the axis of the bore was ·9 of an inch and the gravity fall during the period the bullet travelled six feet was taken at ·06 of an inch, making ·96 the distance which the bullets should strike below the point aimed at when zeroing under the conditions of the particular test in question. The ascertainment of zero elevation, the measurement of mean velocity over 50 yards, and of drop at 50 yards, were all observed immediately after one another. When recording the measurements of drop in the last article a small, but nevertheless important, omission occurred, viz., to deduct from the 50 yards drops the ·9 inch distance which the bullets would strike below the mark aimed at if there were no gravity to consider. This deduction has been made in the following table, and its effect is to bring the results extraordinarily close to the 18-inch drop which formed the basis of the trajectory table already published :—

TABLE I.—EXPERIMENTAL RESULTS FROM WHICH THE BALLISTIC DETAILS HAVE BEEN EXTRACTED.

	Weight of bullet.	Velocity over 10 yards.	Drop due to gravity over 50 yards.
Match.	9·6 grs.	563 f.s.	18·7 in.
Witton.	8·0 ,,	623 ,,	17·6 ,,
B.M.M.	8·0 ,,	595 ,,	18·5 ,,

The fact that the above records were taken with exceptional care, and that variations due to temperature and other causes were practically excluded by taking them simultaneously, suggests that the ballistic coefficient which will harmonise the figures with Bashforth's tables will be so accurate as to enable anyone to calculate all particulars respecting the trajectory of similar forms of air-rifle bullets, no matter what may be their weight and velocity. The ballistic coefficient of a bullet is a mathematical value denoting its capacity for getting through the air, and it is expressed in the following manner :—

$$\frac{w}{n\,d^2}$$

w is the weight in pounds of the bullet, and it needs no argument to realise that the penetrative power of the bullet is directly proportional to its weight. In the same way d^2 is proportional to area, and area means resistance. Consequently this characteristic of the bullet comes below the line. The remaining value n is a factor called the coefficient of reduction, and it expresses the shape of the bullet's nose and its steadiness in flight. These two characteristics affect air resistance in quite as important a manner as weight and diameter. In fact the celebrated Spitzer bullet has a value of n equal to about ·5 instead of the usual ·78 for the blunt nose military bullet, and $n = 1{\cdot}0$ when the characteristic of the bullet is that assumed in Bashforth's table. w and d are known quantities susceptible to direct measurement, consequently the estimation of the ballistic coefficient resolves itself into determining the value of n.

For a bullet fired from a modern air-rifle the diameter can be taken as ·180 of an inch, this representing the necessary surplus on the true bore ·177 to allow for the depth of the rifling grooves. The law of falling bodies was explained at considerable length in one of the earliest lectures, viz., that which appeared in December 1899, and there the following formula appeared :—

$$h = \frac{g}{2} t^2$$

This is another way of saying that the height from which a body has fallen is equal to half the product of gravity and the square of the time of fall. Taking g at its well-known value 32·2, and expressing h in inches, the above equation can be transposed in the following slightly altered form :—

$$t = \sqrt{\frac{h}{193{\cdot}2}}$$

In other words the time of flight of a bullet is proportional to the square root of the height fallen, viz., the drop divided by 193·2. Velocity is simply so many feet in a second : therefore, with a known range and a known time of flight the velocity over the range can be deduced from the measured drop. The actual arithmetic is performed by dividing the time of flight derived from the previous formula into the range in feet. In the following table the resulting values are duly set out, and it will be seen that the measured drops have been converted into velocity over 50 yards :—

TABLE II.—CONVERSION OF DROP INTO VELOCITY.

	Velocity Measured over 10 yds.	Measured Drop at 50 yds.	Time of flight Calculated from Drop.	Resulting Velocity over 50 yds.
Match.	563 f.s.	18·7 in.	0·311 sec.	482 f.s.
Witton.	623 ,,	17·6 ,,	0·302 ,,	497 ,,
B.M.M.	595 ,,	18·5 ,,	0·310 ,,	484 ,,

It is at once evident that the results when expressed in the above new form are at any rate not ridiculous or inconsistent with what might be expected. For short ranges, such as 60 yards or less, it is the practice to take the mean velocity over the distance in question as the actual velocity of the projectile at the midway point. Thus the above velocity over 50 yards ranks as the actual velocity at 25 yards. This is not true in the instances now being considered, but the assumption may be taken as very nearly accurate for the time being. For example the Witton bullet may be said to have the velocities 623 f.s. and 497 f.s. respectively at 5 yards and 25 yards distance from the muzzle. In other words this bullet drops from the higher to the lower velocity in passing through 60 feet of air.

MATHEMATICAL DEMONSTRATION.—From Bashforth's table, viz., the one headed $s = c\,(S_v - S_v)$, if the distance s, over which the change of velocity takes place, is known, viz., when the bullet changes from velocity v to velocity v, the value of c, the ballistic coefficient, is easily obtained. Taking the Witton bullet :

$$s = 60 \text{ feet}$$

$$v = 623 \text{ f.s.} \qquad S_v = 32327{\cdot}8$$

$$v = 497 \text{ f.s.,} \qquad S_v = 28605{\cdot}6$$

$$\text{Whence } c = 0{\cdot}0161 = \frac{w}{n\,d^2} = \frac{8}{7000 \times {\cdot}18^2 \times n}$$

$$\text{Therefore } n = 2{\cdot}19$$

With this value of c the velocity at the muzzle and any distance from the muzzle can be obtained. Table III. which now follows gives successive velocities up to 50 yards for the Witton bullet :—

TABLE III.—STRIKING VELOCITY OF THE WITTON BULLET AT VARIOUS RANGES.

Range.	Velocity.
0 yds. (Muzzle).	659 f.s.
5 ,,	623 ,,
15 ,,	557 ,,
25 ,,	497 ,,
35 ,,	444 ,,
45 ,,	397 ,,
50 ,,	376 ,,

It is clear from these figures that the mid range velocity is not the average over the range. The fall in velocity becomes less and less per five yards as the bullet gets further and further from the muzzle. This method can, therefore, only be used as a first approximation and to give some suggestion of the kind of values which will be obtained. The exact method is by the use of Bashforth's space and velocity table and his time and velocity table. These are based upon :—

$$s = c\,(S_v - S_v)$$

$$t = c\,(T_v - T_v)$$

Combining and eliminating c the relation becomes :

$$S_v - S_v = \frac{s}{t}(T_v - T_v)$$

The drop gives the time in passing over the range s. Further the approximate value of v can be taken as the muzzle velocity, and thus by trial and error v, the striking velocity, is obtained from the tables. Again taking the

$$\text{Witton bullet } \frac{s}{t} = 496{\cdot}7$$

and the approximate value of v and v are 659 and 376, thus :

$$S_v = 33267{\cdot}4 \qquad T_v = 221{\cdot}2881$$

$$S_v = 23956{\cdot}9 \qquad T_v = 202{\cdot}3230$$

$$9310{\cdot}5 \qquad 18{\cdot}9651 \times 496{\cdot}7 = 9420$$

This gives the right-hand side too great a value. Try $v = 400$, which gives the left-hand side too great a value by 183, and by proportion this suggests that $v = 385$ be tried. The left hand side is then 15 too great. Then taking $v = 384$ coincidence is obtained.

MATHEMATICAL DEDUCTION.—Thus to conform with Bashforth's tables a bullet with a muzzle velocity of 659 f.s. taking 0·302 sec. to go 50 yards will have a striking velocity of 384 f.s. This new relation of v and v gives another value of $\frac{s}{c}$ for correcting the observed velocity over 10 yards to the muzzle velocity. The arithmetic is obvious and the new muzzle velocity is 657 f.s., or two feet-per-second less than the approximate one assumed. With this new muzzle velocity a re-determination of the striking velocity at 50 yards must be made. For the Witton bullet this becomes 385 f.s. All the details are now at hand for determining the exact value of n from the observed drop over 50 yards and the velocity over 10 yards, viz.,

$v = 657$ f.s. s_v 33216·5 by tables.
$v = 385$,, s_v 24360·0 ,,

$s = 150$ feet $\quad 8856{\cdot}5 = \frac{150}{c}$

Therefore $c = {\cdot}0169$ and $n = 2{\cdot}08$

Dealing similarly with the other two bullets the particulars in the next table have been obtained :—

TABLE IV.—Ballistics of Air-Rifle Bullets.

	Muzzle Velocity.	Striking Velocity at 50 yds.	*Value of C.*	*Value of n.*
Match.	584 f.s.	403 f.s.	·0245	1·73
Witton.	657 ,,	385 ,,	·0169	2·08
B.M.M.	625 ,,	382 ,,	·0184	1·92

The method adopted for the analysis of these drops and velocities is no doubt more exact than the importance of the experiments warrant. The longer method has shown that for air-rifle bullets the approximate method would have been near enough, but the labour has not been in vain, since it has not only shown the degree of accuracy of the approximate method, but has demonstrated the more exact process which is applicable to bullets for all kinds of firearms. The Match slug is not quite so blunt as the Witton and B.M.M. patterns, therefore its value of n is doubtless less than is the case with its rivals. The value of n for the Witton and B.M.M. slugs may be taken at 2·0. With this value, and by the use of the s_v and τ_v tables the striking velocities and times of flight can be obtained. From the times of flight one may calculate the drop in inches from the axis of the rifle by transposing the formulæ

$$t = \sqrt{\frac{h}{193{\cdot}2}}$$

to $\quad h = 193{\cdot}2\ t^2$.

In this manner a table of drops has been obtained for the Witton bullet which may be compared with those given in the last lecture. It was said that they showed only the general form of the trajectory curve as determined by actual shooting. The drops now determined by careful calculation are as near to those obtained by direct measurement as could possibly be expected :—

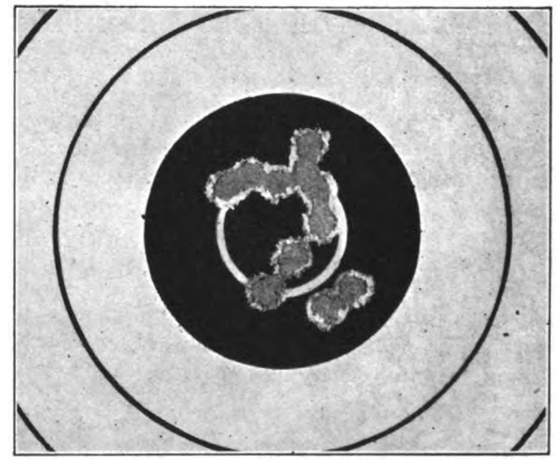
TABLE V.—Comparison of Calculated with Observed Drops.

Range.	Calculated Drop.	Observed Drop.
10 yds.	0·45 in.	0·5 in.
20 ,,	2·0 ,,	2·2 ,,
30 ,,	5·0 ,,	5·5 ,,
40 ,,	9·8 ,,	10·7 ,,
50 ,,	17·2 ,,	18·0 ,,

As the differences between calculated and observed are all in the same direction, they can be attributed to differences of velocity at the times when the various sets of experiments were made. In other words, if the calculated drops were re-calculated for a slightly lower velocity, the differences would practically disappear.

THE NEW K.N. ·22 CARTRIDGE.

The King's Norton Metal Company owe a great part of their success as ammunition makers to their constantly successful efforts to improve the quality of their output by modifications of design or material the result of systematic research. The latest of their ventures is the manufacture of ·22 calibre cartridge cases of cupro-nickel, instead of the usual copper, which strictly speaking is brass, since it contains a definite proportion of spelter. The justification for using a material obviously so much more expensive is its greater toughness, and, therefore, greater suitability for the



purpose in view. To achieve perfection under present conditions is an exceedingly difficult manufacturing problem ; and though the measure of success attained is exceedingly high, the knowledge that cupro-nickel is a feasible substitute for the present metal will be heartily welcome. Mr. T. R. Bayliss is known throughout the world as an authority on metal alloys ; and in no direction has his special knowledge proved of greater practical utility than in the production of high quality ductile cupro-nickel suitable for jacketting the bullet of the service cartridge. The firm's known precedence in this department gives security that there is every prospect of repeating *ad infinitum* the high quality of the sample of nickel ·22 cartridges which have recently been delivered to this office for test. For the purposes of the experiments, a rifle was chosen which, though shooting very excellently, is somewhat prone to pierce the metal cases and so every now and then spoil an otherwise fine target by the wild shooting of a burst case. The nickel cartridge cases by reason of their extra toughness have apparently obviated this defect. At any rate after half a dozen sighting shots had been fired for the purpose of adjusting elevation, the accompanying very fine diagram, which is the best the rifle has ever produced, was obtained at the first attempt. Of all the rounds subsequently fired a slight escape occurred but once, and the marked improvement in the quality of shooting produced was by no means confined to the target illustrated. The rifle was fired from the back position without artificial rest, and the distance though nominally 50 yards was actually 47 yards.

ROUND THE TRADE.

The next sale of guns at Debenham's rooms will take place on Wednesday the 12th inst.

At the annual meeting of Messrs. Greenwood and Batley, Ld. held on the 4th ult., Mr. Arthur Greenwood explained that, although the profit was nearly double that in the previous year, the directors had decided to recommend only the moderate dividend of 4 per cent. on the ordinary capital with a view to increasing the resources of the Company.

By the death of Mr. W. Jeffery of Plymouth in his 94th year the gun trade loses one of its oldest representatives. A native of Lymington in Hampshire, Mr. Jeffery, went to Plymouth, and in 1849 acquired the business of Mr. Harvey, gunsmith, Union Street. In 1862 it was removed to the present premises of the firm of W. Jeffery & Sons in George Street. About 20 years ago Mr. Jeffery retired. Being of a genial disposition, and interesting himself in local affairs, he was very popular and highly esteemed in the neighbourhood.

The New Explosives Co., Ld., whose home trade price-list has just come to hand, give due prominence to their smokeless powders *Shot Gun Neonite*, *Red Star* and *Felixite*, the three-dram charges of which are 30, 33 and 42 grains respectively. A further page is devoted to cheap smokeless powders for second-grade cartridges, *Stowmarket Smokeless* being a bulk 33-grain powder which will be issued only in loaded cartridges, whilst *Primrose Smokeless* of the 42-grain style will be sold in canisters, as well as loaded into cartridges. The page devoted to smokeless rifle and revolver powders speaks highly for the enterprise the Company have shown in dealing with this new department of business, for the family of Neonite includes powders specially made for ·450, ·303, ·250 and ·22 calibres, these covering all sizes of rifle from the smallest up to ·577 bore. Revolver Neonite and Blank Neonite complete the list. The concluding pages of the catalogue are devoted to a list of sporting cartridges, each quality being denoted by the well-known descriptive trade words, such as nitro, gastight, etc.

An application was made last month by Nobel's Explosive Co., Ld. for the ratification by the local authority of an amending licence in respect to the Perranporth factory, which had already been approved by the explosives department of the Home Office. Mr. Hemmerde, K.C., M.P., outlined the history of the factory, and explained that the present proceedings were to decide whether the proposed changes in any way increased the danger to the inhabitants or the landlords of the district. He urged that the powers sought would very largely diminish the risk to everyone concerned. At present they were allowed to store 274,000 lbs. of various explosives, whilst if the application was granted they would be able to store the same amount of general explosives, but instead of 44,000lbs. of cordite they would be able to store 282,000lbs. In the past the output of the works had been from 284 to 957 tons of explosives a year, and under the order now asked for this would cease. Objections were lodged on behalf of Lord Falmouth and other owners of property, as well as the district councils of Newquay and St. Agnes, by Mr. R. Dobell who condemned the scheme on the ground that it established a huge magazine at Perranporth, the presence of which would mean danger. He further suggested that the intention was to store cordite rejected by the Government. The Bench, after hearing evidence on both sides, decided that the amended licence should be dissented from on account of the general disadvantage to the interests of the neighbourhood. Mr. Hemmerde said that though he had a right of appeal, he would prefer that the Bench would state a case for a higher court, and this they agreed to do.

Under the title of The European Target Syndicate Ld. a company has been registered with £10,000 capital, for the purpose of acquiring certain patents in sub-target and other allied inventions, and at some future period of promoting a company to take over the business established.

The London Armoury Co., Ld., have lately forwarded a copy of the latest Winchester catalogue, No. 74, which has just arrived in the country. It contains the usual detailed statistics of this Company's immense assortment of rifles, shot guns and pistols on the one hand, and on the other the cartridges for use in an even more miscellaneous assortment of weapons.

Captain Desborough has issued his report concerning the circumstances of the explosion which occurred at Messrs. Curtis's and Harvey's Roslin factory in March last. It apparently arose from the use of metal stitches in a cardboard box containing some gelignite cartridges. One of these stitches may have projected inside through not being fully rivetted down, and have come into contact with a congealed film of nitroglycerine.

The Schultze Gunpowder Co., Ld., have forwarded a copy of their cartridge price-list for the coming season. The *Rainproof*, the *Eyeworth*, the *Westminster* and the *Yeoman* cartridges are sold on a price maintained basis. Although the list necessarily contains only the particulars which one expects to find in a catalogue of this kind, there is nevertheless evidence on every page that great care has been taken in displaying the matter in the best possible way to facilitate reference. Besides the proprietary cartridges the Company load the stock varieties and also carry on a general business in the direction of loading customers' named cases with any powder.

A meeting of the debenture stock-holders of the National Explosives Co., Ld. was held on the 17th ult. to consider a contract for the sale of the assets and undertaking to a new company. It was explained that the present scheme was the only possible one for raising the money required, and if it passed there seemed no reason why the Company should not in some measure return to its former prosperity. Proxies representing over £92,697 of debentures out of a total issue of £142,000 had been received in support of the scheme. When all the expenses were paid the new company would have about £25,000. The new scheme was unanimously approved.

THE balance sheet of Messrs. Kynoch, Ld. for the year ended March 28th last shows a profit of £20,535. After deducting directors' fees, £2,000, as against £5,000 in the previous year, and debenture interest, there is a deficit of about £1,500, which will come out of the £45,145 brought forward from the last account, as also will the preference dividend of 5 per cent., free of income tax, leaving £19,680 to be carried forward. Mr. George Hookham, speaking on behalf of the chairman of the Company who was away ill, dealt fully at the annual meeting with the falling off in the year's profits. This arose mainly from purchases of metal having been made at an unfavourable moment.

The firm of Charles Osborne & Co., Ld. have undoubtedly done well to undertake the manufacture of single-barrel shot guns on the lines of the American designs which sell in such large quantities both here and abroad. The sample gun which they have sent to this office for examination and report is in several respects an improvement on some of the competing American designs. The barrel is not only straight but exceedingly true to gauge, being moreover choked at the muzzle to an extent ensuring very close patterns. The weight is stated in the catalogue as about 6½lbs., but the sample under notice weighs 6lbs. The breech closure and general design of the mechanism are conceived on sound lines. There is a powerful ejector, and the hammer blow is exactly standard, as tested on the Irvine gauge.

GUNCOTTON IN FRANCE (1846).

By George W. MacDonald, M.Sc., F.C.S.

—4—

The announcement of Schönbein's discovery aroused in the French Academy a remarkable interest. The *Comptes Rendus* of 1846 and 1847 contain a very large number of interesting communications on this particular subject and it would be impossible, in a short space, to summarise them. Two communications, however, one by Dumas, the other by Pelouze, are of sufficient historical interest to be dealt with in detail. Schönbein wrote to Dumas (1) as follows:—

"You know, perhaps, that I have discovered a very simple method of transforming ordinary cotton into a material possessing all the necessary properties as a propellant. In addition to the superior explosive force of this curious substance, it is in every respect superior to the best powder. Experiments which I have made in mines and quarries and with cannons and mortars have shown that one pound of this substance produces effects equal to from 2 to 4 pounds of ordinary black powder. It should be added that cotton so treated does not leave any residue when exploded and produces no smoke. The manufacture is not attended with the least danger, and does not require any costly installations. In view of these properties we cannot doubt that this explosive cotton should rapidly find a place in the pyrotechnic arts and especially on war vessels."

Dumas' (2) own communication was as follows:—

"Arago having questioned me at the meeting of the Academy on October 7, 1846, on the subject of guncotton, I then stated that, although the details to hand were very meagre, I considered the subject to be one of very great importance, and that the new explosive substance would probably be found to be related to xylöidine discovered by Braconnot and further studied by Pelouze. It appeared to me to be only right to allow Schönbein to present the details of his discovery in the manner which he considered most convenient. Certain details of the manufacture of guncotton have already been published in Germany, and I think it right that, as I have confirmed their accuracy, they should appear in the Transactions of the Academy. At the same time it will give an opportunity to Pelouze, to present to the Academy certain results which he has obtained as to the force of this new product. Otto, of Brunswick, gives the following details as to the preparation of guncotton. Concentrated fuming nitric acid, obtained by heating a mixture of 10 parts of saltpetre and 6 parts of sulphuric acid, has the property of converting cotton into an explosive. The acid first passing over acts most energetically in this respect. Cotton is dipped for half a minute in this acid. It is then pressed between two pieces of glass, washed until free from acid, and afterwards dried. The dry material will be found to be extremely explosive. Should a fresh quantity of cotton be dipped in the acid which has already been once used it will be noted that the resulting product is only feebly explosive. If, however, this latter product is washed and dried and again dipped in acid it will now be found to possess sufficiently strong explosive properties. The explosive property can be considerably increased by several dippings, and I have found that a product of extreme force is obtained after an immersion of 12 hours. A point of extreme importance is the care which ought to be exercised in washing the cotton. The last traces of acid are very difficult to remove, and should any remain it will be found that, on drying, the body smells strongly of oxides of nitrogen, and when ignited a strong acid smell is also produced. The best test for a sample of guncotton is to ignite it upon a porcelain plate. Should it burn slowly, leaving a residue upon the plate, it must be considered as unsatisfactory. A good guncotton burns very violently without leaving any residue. It is also of very great importance that when the guncotton is withdrawn from the acid it should be washed immediately in a large quantity of water. Should small quantities of water be used it will be found that the guncotton becomes very hot, and that spots of a blue or green colour are produced, which are very difficult to remove, and the guncotton is very impure. Dr. Knopp, of the University of Leipzig gives the following details. Equal parts of English commercial sulphuric acid and commercial nitric acid are mixed in a porcelain basin. As much cotton is taken as can conveniently be dipped in the liquid and after it is immersed the basin is covered with a piece of glass. After standing for several minutes, at the ordinary temperature, the cotton is withdrawn and immediately washed in cold water. When dry it is extremely explosive.

Care should be taken that the cotton remains in the acid only sufficiently long to be partially dissolved. It would appear that a satisfactory guncotton can be obtained without observing any great exactitude as to the weight of the two acids and the time of immersion. On using a mixture containing a smaller proportion of sulphuric acid and immersing the cotton for a shorter time, a satisfactory product was nevertheless obtained. Dr. Bley of Bernberg has made experiments on the use of substances less costly than cotton. He has discovered that sawdust treated in the same way as cotton is converted into an explosive body which might very readily serve to replace ordinary powder in firearms and blasting." Pelouze (3) wrote as follows:—

"On a former occasion when noticing the discovery of this new explosive material, supposing it to be the product of nitric acid on cellulose (cotton, paper, lignine, etc.), I observed that it was undoubtedly the combustible substance which I described in 1838, and which must contain more oxygen and therefore more nitric acid than the xylöidine of Braconnot, *i.e.* the pulverulent and amorphous substance, which that chemist obtained on precipitating by water a nitric acid solution of starch made in the cold, or one of cellulose effected at a higher temperature. This has proved to be the case. In what follows I shall attempt to show that the xylöidine of Braconnot and the substance which I obtained by impregnating various ligneous substances with concentrated nitric acid are not identical, as I long believed with chemists in general. I shall call *pyroxyline* or *pyroxyle* the product of monohydrated nitric acid on cotton, paper, and ligneous substances, when this action has taken place without having caused the solution of the cellulose. Xylöidine will henceforth designate the substance obtained

by Braconnot by precipitating the nitric acid solution of starch and other ligneous substances. The following are the differences observed between the two substances.

Xylöidine is very soluble in nitric acid and this solution, which is quickly effected, becomes decomposed in the course of a day. Xylöidine is then converted into a deliquescent acid which I described eight years ago. (*Arms and Explosives*, June, 1908). Pyroxyline does not dissolve even in considerable excess of nitric acid. It may be left in it for days without disappearing, or any loss of weight. Xylöidine, though very inflammable and detonating when struck, leaves when heated in a retort a considerable residue of carbon. Pyroxyline, as is well known, behaves quite differently. When heated from 175°C–180°C it explodes violently, and its distillation in a retort is physically impossible. Xylöidine may be analysed like any other substance by means of copper oxide. Pyroxyline under the same circumstances breaks the tube even when quantities 100 times smaller are used. Five mgrms. of pyroxyline heated in a tube filled with mercury produced a violent detonation; whilst quantities far more considerable of xylöidine may be decomposed in this way without any danger. One hundred parts of dry starch, dissolved in concentrated nitric acid, and precipitated immediately on its solution, which is very rapid, yield at most 128 to 130 parts of xylöidine. One hundred parts of cellulose (paper, cotton), yield either after a few minutes or several days immersion in concentrated nitric acid, 168 to 170 parts of dry pyroxyline. These two experiments are the more characteristic, as the acid liquids which rest above the pyroxyline and the xylöidine contain nothing but mere traces, of organic matter. Eight years ago I determined the composition of xylöidine. I concluded from my analysis that it might be represented by one equivalent of starch which had lost one equivalent of water and taken up one equivalent of nitric acid. I still believe this composition to be correct. However, xylöidine is amorphous, and insoluble in water. It is derived from a substance which is never perfectly pure, and it is likewise amorphous and insoluble, and at present we possess no means of judging of the purity of a substance occurring under such unfavourable conditions. It is possible, therefore, that xylöidine and pyroxyline contain one and the same substance, the properties of which are more or less masked by the presence of some hitherto unknown substance. The point on which I insist is that the two compounds in the state in which we are at present acquainted with them differ too considerably to be considered identical. A Dutch chemist, Ballot, considers xylöidine to be a mixture of several substances, which have no longer any direct connection with starch. Be this as it may, the analysis of this chemist removed the composition of xylöidine from that of pyroxyline far more than mine. I selected some samples of cotton and paper which left but a mere trace of ash. I dried them at 115°C and submitted them to the action of either concentrated nitric acid or a mixture of concentrated nitric acid and sulphuric acid. In ten experiments which lasted from 10 minutes to 48 hours the increase in weight of the cotton and the paper was practically the same.

It was constantly comprised between 68 and 70 for every 100 parts of dry cotton or paper. This identity between cotton and paper relative to the action of nitric acid is not surprising, as paper, excepting traces of foreign matter, is nothing more than cotton the fibres of which have been more or less disintegrated. The remarkable fact in these experiments is the consistency of the results, the rapidity with which the combination takes place, notwithstanding its insolubility and that of the cellulose. It is in fact a true atomic relation between the elements of a combination effected by mere impregnation and under unusual circumstances. Admitting what appears to be true, that nitrated cellulose is the sole product which originates in the preceding reaction, calculation indicates that it must result from the combination of two equivalents of monohydrated nitric acid, with one equivalent of cellulose minus one equivalent of water. Having endeavoured without success to analyse pyroxyline I employed to determine the composition of this substance an indirect method, which, however, I believe to be unobjectionable. Having ascertained that 100 parts of cotton yield, on the average, 169 parts of dry inflammable substance, I neutralised the whole of the acid liquor in which I had immersed the cotton, and concentrated the resulting nitrate of ammonia in a glass retort, to which I had adapted a tube for collecting the gases. The ammonium nitrate was decomposed, just as if it were pure into nitrous oxide and water. I was not able to detect the presence of carbonic acid in the gases, from which I concluded that no other organic substance was formed at the same time as the nitrated cellulose, and as no gas is disengaged in the preparation it may be concluded that it has, in fact, the composition above indicated. In summing up the preceding observations and experiments I think I am able to establish in a positive manner, that xylöidine and nitrated cellulose differ, not merely in their properties, but also in their composition. I had considered with all chemists that there were merely some slight differences in these two substances arising from their different degree of cohesion and resistance to solvents, similar to what is manifested between starch and cellulose as proved by Payen, but this is not the case. They are in reality two bodies possessing different compositions and properties."

The author then offers some remarks on the expense of producing the new substitute for gunpowder and sums up the history of its discovery as follows:—

"Xylöidine and pyroxyline are, as far as we are acquainted with them at present, not identical. Braconnot discovered xylöidine. I discovered the singular substance pyroxyline by a process entirely new and which no one before me had previously suspected. I pointed out its extreme combustibility and suggested its appreciation in artillery. To Schönbein is due the honour of having shown that this substance constitutes an explosive material far more energetic than gunpowder. In conclusion the only method as yet known for preparing this new explosive substance is that which I described in 1838, Schönbein having hitherto kept secret both the nature and preparation of his guncotton.

(1) *Comples Rendus* 1846. (2) *Comples Rendus* 1846. (3) *Comptes Rendus* 1846.

EXPLOSIVES REPORTS.

WESTERN AUSTRALIA.

Importation.

Mr. E. A. Mann, Chief Inspector of Explosives, publishes in his annual report for last year the following comparative table of importations :—

Kinds and Quantities of Principal Industrial Explosives imported in 1906 *and* 1907.

Gelignite	2,554,565	2,469,780
Blasting Gelatine	445,650	552,600
Gelatine Dynamite	424,250	297,500
Dynamite	7,000	..
Blasting Powder	112,544	282,750
Sporting Powder	4,500	3,057
Total	3,548,509	3,605,687

Other tables appear which show that although the quantity has been slightly increased the value has diminished from £199,253 in 1906 to £122,592 in 1907. The values given in the customs returns have shown a remarkable drop since the imposition by the Federal Tariff of an ad valorem duty in connection with the Commonwealth preferential trade proposals. It appears that either the cost of manufacture of explosives has been very greatly diminished, or that the old rates of values, which have been employed in the Customs declarations for some years were misleading. In the past the values have represented the old rate of cost manufacture, or were maintained at a high standard for commercial purposes, but now that this duty has been imposed the manufacturers have naturally been quick to reduce their declared values to a limit more nearly representing the true cost ; while the annual value of the trade has therefore diminished, its volume, as shown by the quantities imported, has actually increased.

Mercury Perchlorides.

According to the report special interest was given to the testing work carried out during the year, by the discovery in July of the presence of perchloride of mercury in considerable quantities of explosives imported into this State. Mr. Mann then proceeds to detail the facts connected with the discovery of mercury in explosives forwarded to Australia, and the steps taken to check the practice.

The result was that 1,932 cases, representing 96,600lbs. of Gelignite, Gelatine Dynamite, and Blasting Gelatine were seized and condemned, in addition to which proceedings were taken against the importers of the goods in three instances, and a fine of £100 and costs was imposed in each case.

The methods of analysis employed for the detection of mercury in nitroglycerine compounds were as follows :—

Two hundred grammes of the explosive were ground up with 400 grammes of French chalk, and 250 cc's. of water added, the whole allowed to stand for 24 hours. The solution was then filtered, slightly acidified with H_2SO_4, subjected to an electrical current of 1·5 amperes, and the mercury deposited on a gold cathode using a platinum anode.

The electrolysis was conducted for three to six hours. The cathode was detached, washed with water, alcohol, and ether, carefully dried at a low temperature, and weighed, the increase of weight being taken as Hg_2.

The cathode was then placed in a test tube and heated to redness, keeping the upper part of the tube cool. The mercury was volatilised and deposited on the tube. The subl mate which was often invisible to the eye, was made discernible by the addition of a small grain of iodine and gentle warming. The iodine vapour after filling the tube subsides, leaving a red deposit of HgI_2.

As over two hundred tests were to be made, the following more simple and rapid qualitative method was devised :—

Two hundred grains of the explosive were ground with 400 grains of French chalk, and placed in a large tube, which had suspended from the cork a piece of silver foil. The tube was heated in a bath of 71 deg. C. for two hours.

After cooling, the foil was removed to a test tube and heated strongly. The consequent sublimate of mercury in the upper part of the tube was detected by the use of iodine vapour as described above.

Burning of Fuse.

Another matter which has received considerable attention during the year has been the testing of fuse imported for use in our mines. As was pointed out last year, the question of the burning rates of fuse and the relation of fuse generally to mining accidents, is one which requires careful attention. The regulation which was imposed specifying the burning rate (for mining purposes) of 80 to 100 seconds per yard, was alleged by some to be an impracticable one, but experience has shown that it is quite possible to keep within these limits.

Three hundred and eleven samples of fuse were tested in the ordinary way during the year, and of these only 28 samples went beyond the limits prescribed by the regulation. Of these 17 went over, and 11 under the prescribed limits of 80 to 100 seconds per yard. The remaining 287 samples of fuse examined were the result of special tests made to try to throw some light on the alleged quick burning of fuse. From time to time in connection with accidents on the goldfields, it has been alleged that samples of fuse have "run through," causing premature explosion. In the course of thirteen years' inspection of the fuse of this State, involving the examination of many thousands of samples, Mr. Mann has never encountered one which "ran." A sample might occasionally explode or mis-fire, but an attitude of scepticism has always been adopted towards any report which described the "running through" of an ordinary safety fuse.

It might on the face of things be possible that "short circuiting" occurred, due to the local method of handling the fuse in mines. When a miner fires a "round" of holes, it is customary for him to tightly double up the length of fuse protruding from the holes and force it, in a crushed condition, into the mouth of the bore hole, this being done to prevent the fuse being cut by flying stones, etc., from the earlier holes in the "round." This treatment might, by injuring the wrapper of the fuse and putting it in a state of strain, cause the flame, when such a fuse was ignited in its turn, to communicate from one bend of the fuse to another at a point much closer to the charge, thus causing the latter to explode very much sooner than was expected, and giving rise to the idea that the fuse had "run."

No.	Ordinary Rate of Burning. Seconds per yard	In Tube. Seconds per yard.	No.	Ordinary Rate of Burning Seconds per yard.	In Tube. Seconds per yard.
1	85	112	16	104	116½
2	100	120	17	98⅓	115
3	102·5	120	18	99	116½
4	105	120	19	101⅜	130
5	96⅙	125	20	99½	130
6	90	122½	21	104	112½
7	90⅝	108	22	105	127½
8	96⅔	125	23	97½	126
9	79	125	24	79	125
10	97½	124	25	101	112½
11	96⅔	120	26	97	117½
12	100	105	27	96⅔	125
13	91⅔	110	28	97½	125
14	105	120	29	95	125
15	104	126	30	95	125

In order to test this, galvanised iron tubes were employed of 1⅛in. internal diameter, the size of the ordinary machine hole, and about 12ins. long, and lengths of fuse 6ft. long, about the average length of the miner's "stick," were coiled or bent and tightly crushed into these tubes. They were then burned along-side of lengths of the same fuse laid out on the ground in the ordinary way. The results were very striking. Out of several hundred tests, no increase of speed was manifested by the samples in the tubes, and in fact, as a general rule, by this treatment the rate of burning was retarded, in some cases to a considerable extent. This is illustrated by the above table taken at random from the schedule of tests. Of the total number of 287 fuses tested in tubes 107 showed a retardation as compared with fuses burnt in the open, while only *two* showed an acceleration of speed, and this very slight.

While this method of treatment, therefore, has no effect in *accelerating* the burning rate of the fuse, and the tests still further emphasise the improbability of any of the safety fuse "running through" during use, it is of som importance to note that a certain retardation of explosion may be caused by this doubling of the fuse, and give an additional reason for discouraging the tendency, which often exists, for men to return too quickly to holes which they suspect have missed fire.

VICTORIA.

MR. C. Napier Hake, chief inspector of explosives, in a brief report dealing with the year's work of his department refers to several matters which received his attention during the six months' leave of absence which he spent in Europe.

IMPORTATIONS.

The following table shows the importations for the year 1907 compared with the year 1906 :—

Name of Explosive.	1907.	1906.
Gelignite	948,900	1,001,150
Gelatine Dynamite	310,500	309,950
Blasting Gelatine	120,300	164,250
Cheddite	15,000	43,100
Bobbinite	Nil	50
Rippite	6,400	2,000
Powder, Fuse	77,000	87,500
Powder, Blasting	155,000	183,650
Powder, Sporting	26,675	39,875
Total	1,659,775	1,831,525
	Total Number.	
Detonators	3,575,800	2,906,500

The mercury question, which arose in connection with some of the importations, is dealt with in the following paragraph :—"The explosive imported was generally of a satisfactory quality, with the exception of some brands which were found on examination to contain Mercuric Chloride, the presence of which made it difficult to arrive at a true measure of the stability of the explosive.

The question of the legality of adding this ingredient to explosive was under official investigation when I was in London, and I took full advantage of the courtesy of H.M. Inspectors of Explosives, who gave me full and confidential information in regard to their views and the action they proposed taking, which enabled me to deal with the question promptly and satisfactorily.'

Other matters receiving the attention of the department during the year were of a routine nature, and do not require special comment.

CAPE COLONY.

MR. Jervis E. Foakes, chief inspector of explosives, in his report for 1907 gives the following table of importations :—

	Total Quantity.		Total Value.	
	1906.	1907.	1906.	1907.
Dynamite, Blasting Compounds and Powder ..	lbs. 4,295,836	lbs. 4,053,190	£ 144,419	£ 133,801
Gunpowder ..	72,786	51,658	6,513	4,807
Nitro-Cotton ..	89,909	196,146	6,210	13,689
Fuse and Detonators	—	—	30,705	26,215

The above table indicates a slight decrease in the amount of explosives imported, but the increased output at the Cape Explosive Works indicates a growth in the total consumption. The monthly production at this factory is given as follows, and represents an increase on last year of 37,000 cases.

	Dynamite.	Blasting Gelatine.	Gelignite.	Total.
January ..	9,887	11,019	5,225	26,031
February ..	7,355	9,088	7,784	24,227
March . ..	7,953	11,987	4,726	24,666
April	4,880	11,699	8,975	25,554
May	5,090	12,665	10,360	28,115
June	5,749	13,102	7,460	26,311
July	8,805	15,056	6,850	30,711
August ..	10,660	11,105	6,842	28,607
September ..	8,430	13,751	6,099	28,280
October . ..	6,882	11,900	7,434	26,216
November ..	6,700	14,358	9,147	30,205
December ..	6,081	11,118	8,699	25,898

The following observations appear in the report :—

A scheme for the manufacture of cordite and ammunition in Cape Colony, which occurred to me some considerable time ago and was held in abeyance awaiting a suitable opportunity, has now been brought forward.

I pointed out that in the event of great Britain's being engaged in a European war the western route to South Africa might be temporarily impassable, and the Suez Canal on the eastern blocked. The supply of imported ammunition would then cease and South Africa would have to rely on the stock in hand, which might, should a native war arise concurrently, soon be seriously reduced. It would then be invaluable both to the naval and military forces to have a factory in the south which could supply not only South Africa but other colonies in the Southern Hemisphere, and even supplement the supply to India.

The geographical position of the Cape and its proximity to the naval base admirably suits it for the purpose, being so far to the south it is not likely to be interfered with during a European war, and ammunition or cordite would be sent from it to other British colonies in the south without a convoy, while if the supply were derived from England a strong convoy must necessarily accompany it at a time when the war vessels might be urgently needed elsewhere.

The climatic conditions at the Cape, too, are favourable for the manufacture and storage of explosives. All explosives and ammunition manufactured could be stored in a moderate temperature until issued, instead of first having to undergo the severe strain of passing through the tropics, which may occasionally affect the permanent stability of the explosives.

APPLICATIONS FOR PATENTS.

JUNE 22—JULY, 1908.

13,332. Cartridge Slide. J. H. D. Savile.
13,335. Ordnance Sighting Apparatus. A. T. Dawson and G. T. Buckham.
13,468. Rifle Practice Apparatus. F. Mitchell.
13,538.* Automatic Guns. A. T. Dawson.
13,567. Air-Guns. C. G. Bonehill and H. Homer.
13,585.* Gas-operated Guns. W. P. Thompson.
13,742.* Firearms. O. H. Peak.
13,813. Range Finders. A. Barr and W. Stroud.
13,821. Small Arms Projectiles. G. Hookham and Kynoch, Ld.
13,880. Firearms. A. Tomischka.
13,890. Waterproofing Blasting Cartridges. A. Larsen.
13,926. Range Finders. A. Barr and W. Stroud.
13,995. Ordnance Ammunition Supply. F. Wigley and F. Duncan.
13,996. Run in and out Gear. F. Wigley and F. Duncan.
14,076. Rifle Sight. A. E. Swift.
14,159. Single-trigger Mechanism. S. A. Leonard.
14,310.* Lessening the sound of Gun Discharge. H. P. Maxim.
14,442.* Time Adjusting Device for Firing. O. Angelini and G. Ascoli.
14,676.* Cartridges for Automatic Firearms. H. Borchardt.
14,966. Gun Mounting. A. T. Dawson and C. A. Larsson.
15,012.* Firearms. R. E. Reardon and S. W. Graham.
15,045. Explosive Grenades. F. M. Hale.
15,072. Spring Guns. A. Hester and C. Lichfield.
15,074. Recording Target. W. M. Beasley.
15,125. Projectiles. E. J. D. Newitt.
15,195.* Blasting Explosive. W. Eberle.

*These applications were accompanied by complete specifications

SPECIFICATIONS PUBLISHED.

JUNE 25—JULY 23, 1908.

COMPILED BY HENRY TARRANT.

11,369 (1907). **Waterproofing Projectile Fuses.** The Electric and Ordnance Accessories Co., Ld., and R. F. Hall, Birmingham. Fuses of the kind dealt with in Patents Nos. 18,157, 1898, and 16,517, 1906, have the leather or cloth washers between the composition rings substituted by washers made of "hargraf," a rubber compound. The gun-powder pellets are coated with a film of cordite and are treated with a waterproof varnish composed of acetone, shellac, and celluloid. Accepted June 15, 1908.

12,228 (1907). **Range Keepers.** Lieut. A. T. Dawson and G. T. Buckham, London. This bulky specification relates to range keepers which are employed for automatically indicating to the gunners the varying distance between the gun and the target. Instead of employing a clock movement for driving the keeper, and hand gear for actuating the rotary transmitting switch, both these operations are effected by electricity. The motor may be worked at any given speed. Accepted June 29, 1908.

12,378 (1907). **Compressed Guncotton Charges.** The New Explosives Co., Ld., London, and J. A. Carter, Stowmarket. Hitherto gun cotton charges have been made to fit torpedoes or shell by compressing the pulp into moulds by means of pressure exerted in a longitudinal direction, and afterwards turning them in a lathe to bring them to correct shape. The present patentees make the charge in longitudinal sections or halves of the requisite shape by compressing the pulp with a pressure exerted in a direction transverse to the longitudinal axis. Turning is not needed. Accepted June 29, 1908.

12,994 (1907). **Multiple Cartridge Boxes.** H. R. Lemly, U.S.A. A series of leather boxes are permanently attached to a flexible back so that a group may easily be attached to a belt worn by the shooter. The leather boxes are adapted to take clip loads of cartridges in paste board cases. Accepted June 5, 1908.

13,122 (1907). **Automatic Rifle Mechanism.** K. Ebert, Germany. In breech mechanism of recoil loaders knee or tozzle link locking parts are so constituted that one link passes right through or by the other so that the utmost length of extension is greater than the length of both members of the link taken together. Accepted June 9, 1908.

13,194 (1907). **Automatic Ordnance.** Lieut. J. Theofanidis, Greece, and A. Pallis, Liverpool. Barrel recoil ordnance is automatically operated even to the firing through the medium of a fly wheel which stores up the energy of recoil and distributes it through a separate operating shaft. The gun is returned to the firing position by a spring. Accepted June 9, 1908.

13,306 (1907). **Ordnance Sighting Apparatus.** Professor A. Barr, Glasgow, and Professor W. Stroud, Leeds. A new form of sighting apparatus for ordnance is provided with means for imparting a movement to a range element in direct proportion to the increment of range transmitted in conjunction with means for indicating therefrom the increment of angle of the gunsight corresponding to that increment of range although the increments of range and angle are not proportional. Accepted June 9, 1908.

13,528 (1907). **Transport of Light Automatic Guns.** Lieut. A. T. Dawson, and G. T. Buckham, London. Three carrier frames of leather-covered metal are adapted to be strapped to the backs and shoulders of three men, one of the frames being shaped to receive the light piece of automatic ordnance, another the mounting, and the third the ammunition. Accepted June 11, 1908.

13,904 (1907). **Ordnance Sighting Gear.** A. F. Petch, R. Redpath, and T. A. Petrie, London. Calibrating systems are rendered unnecessary in compensating for the changes of angle due to loss of velocity by the introduction of a train of toothed gearing arranged so that the motion of each of its members is one of simple revolution around a fixed axis only. The effect of this mechanism is easily found by process of multiplication. Accepted June 15, 1908.

14,373 (1907). **Improvements in the War Office Miniature Rifle.** The Birmingham Small Arms Co., Ld., A. H. M. Driver, and G. Norman, Birmingham. (*See Selected Patents*).

14,866 (1907). **Target Apparatus.** P. H. Wanner, Switzerland. A target holder by means of which a target is carried by an endless wire to the butts from the firing point and is swung into proper position at the right moment. As the target moves towards the butts another travels to the firing point. Accepted June 25, 1908.

15,014 (1907). **Ordnance Firing Mechanism.** Lieut. A. T. Dawson and G. T. Buckham, London. In firing mechanism of the lock and box slide type certain objections are removed by the provision of means whereby the initial movement of the pinion crank causes the striker to be retracted with certainty prior to the commencement of lateral movement of the lock frame in the box slide. Accepted June 4, 1908.

15,234 (1907). **Signalling Apparatus for Ordnance.** Lieut. A. T. Dawson and G. T. Buckham, London. In electrical signalling apparatus a portable transmitter is specially intended for use with the system of indicating range and deflection to the sight setter dealt with in Patent No. 4,404, 1906. This improved transmitter is also applicable to systems such as that described in Patent No. 11,607, 1907, and in the patentees' earlier systems. Accepted July 2, 1908.

15,19 (1907). **Balanced Target Mechanism.** C. Reid, Dublin. A simplified and improved form of the balanced target mechanism described in patent No. 6, 1906, is dealt with in the present specification. Accepted June 25, 1908.

15,663 (1907). **Rifle Carrier for Mounted Men.** Major S. F. Crocker, India. The barrel fixing of this rifle carrier is made rigid so that the rider back is not bruised by contact with the barrel. The bucket is altered so as to obviate danger should the rider be thrown, and the strap is passed through the trigger guard instead of being fixed to it as heretofore. Accepted June 25, 1908.

18,179 (1907). **Loading Arrangements for Ordnance.** A. F. Petch and F. Duncan, London. In ammunition supply arrangements for naval ordnance, the shell bogies at the

base of the trunk are carried on circular rails so fitted up that the trunk can rotate within the circular rails, whilst the latter is prevented from rotating with respect to the ship by a connection which will not jamb the trunk or track, should the ships bottom be distorted. Accepted June 4, 1908.

18,637 (1907). **Loading Double-Barrelled Sporting Guns.** W. J. Seton, London. A stiff piece of metal is provided on its face with two sets of lugs adapted to take the bases of two cartridges. They are held in such a position that they may be at once introduced into the chambers of a double-barrelled gun, and the holder may easily be removed. Patent No. 8,674, 1903, dealt with a similar device. Accepted June 18, 1908.

20,234 (1907). **Ordnance Sighting Gear.** A. F. Petch and F. Duncan, London. A method is described of supporting an overhanging heavy ordnance sight by means of supports between the sight and gun cradle, these supports being rigidly attached to the cradle or slot, passing through slots or holes in the trunnion brackets on which the cradle or slide is mounted. Accepted June 4, 1908.

20,586 (1907). **Shooting Gallery Apparatus.** I. Sutherland, Australia. A cinematograph is adapted to throw moving figures on to the fixed screen or target surface. When a shot strikes the figure the cinematograph is automatically stopped. Accepted June 18, 1908.

20,629 (1907). **Target Apparatus.** H. L. Cole, Derby. A wheel is provided with four target clips and is held in either one of two positions by a spring catch. The marker has to disengage the catch in order to revolve the wheel and carry into view two clean targets bringing down by the same operation the two which have been shot at. Accepted June 25, 1908.

21,403 (1907). **Primers for Ordnance.** Capt. S. A. de Castilho, Brazilian Navy. A combined electric and percussion primer is so constructed as to be sealed against the passing of gas through the head when fired. A conical passage contains a ball between the detonator and the electric bridge. Accepted June 25, 1908.

22,946 (1907). **Single Trigger Mechanism for Double-Barrelled Guns.** W. Fairweather, London. (Agent for *Schoverling, Daly and Gales, U.S.A.*). (*See Selected Patents*).

23,834 (1907). **Blasting Fuses.** J. Bramwell-Smith, Derby. A blasting fuse consisting of a holder for securing the fuse in position, a straw tube containing the gunpowder carried by the holder, and igniting wires. After ignition the straw is burnt through at its fixed end and travels like a rocket down the borehole to the main charge. Accepted June 11, 1908.

25,122 (1907). **Automatic Pistol Mechanism.** T. A. Fidgeland, Norway. An improved breech bolt is described for pistols in which the reloading takes place without the bolt being turned. The bolt is screwed into the casing and is locked in position by the vertical screw, which carries the back sight. Accepted July 2, 1908.

1,384 (1908). **Blasting Cartridges.** E. & S. Purcell, Pontefract. To prevent the accidental withdrawal of detonators from the usual form of cardboard blasting cartridge case a disc is adapted to take over the wires of the detonator and is provided with flanges on its periphery which engage the top of the case. Accepted June 18, 1908.

1,668 (1908). **Combination Gun and Cross-Bow.** P. Lentz, Germany. The projectile is propelled through the barrel by means of a rod operated by springs after the style of a cross bow, situated on either side of the gun. The barrel is rifled and the projectile has ribs to fit the rifling grooves. Accepted July 2, 1908.

2,509 (1908). **Weather Proof Blasting Explosives.** Dr. C. Claessen, Berlin. Ammoniacal saltpetre or mixtures of this substance and potassium nitrate or sodium nitrate are intimately mixed with aniline metallic compounds in order to render them weatherproof. Aniline-metallic salt compounds are also carbon vehicles. One example of such an explosive is 90% ammoniacal saltpetre, and 10% of chloride of calcium-aniline. Others are given in the Specification. Accepted June 11, 1908.

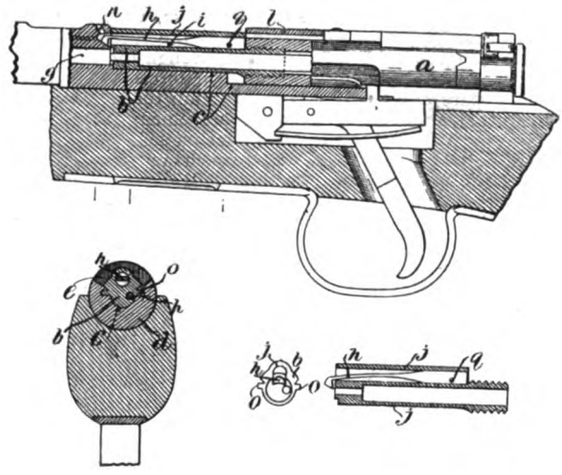
4,468 (1908). **Priming Composition.** F. Wöhler, Germany. The patentee has ascertained that it is possible to produce the same priming action as has been produced by the use of fulminate of mercury, with heavy metal salts of hydrazoic acid (N^3H). As an example of a detonating cartridge the following is given :—One gram of picric acid or trinitrotoluol is placed in the copper cartridge case and 0·023 of a gram of silver nitride (the silver salt of the acid N_3H mentioned above) is placed in a layer on top of the charge. A perforated thimble is placed over the contents and the mass is compressed in the usual way. These metal hydrazoates may be employed for filling primers either alone or in combination with small amounts of sensitive explosives. Accepted July 2, 1908.

7,184 (1908). **Removal of Gases from Ordnance Barrels.** Fried Krupp, A.-G., Germany. The suction apparatus described in Patent No. 12,658, 1905, which has hitherto been used only with wedge breech mechanism is according to this specification applied to cam and screw pattern breech mechanism, in which the breech opening is situated in front of the breech end of the barrel. Accepted June 4, 1908.

SELECTED PATENTS.

THE WAR OFFICE MINIATURE RIFLE.

14,373 (1907). The Birmingham Small Arms Co., Ld., A. H. M. Driver and G. Norman, Birmingham. The bolt head of the War Office pattern miniature rifle is made separate from the body of the bolt but is secured thereto by screw connection. Hitherto the extractor spring was entirely exposed, and in the event of the bursting of the base of the rim fire cartridge generally used in this type of rifle, was liable to be removed by the gases of combustion escaping rearwards. The new form of bolt head dealt with in this patent provides a tunnel way for the extractor, entirely enclosing it and obviating all risk of breakage.



The appended drawings clearly illustrate the improved parts. The body *a* of the bolt and the bolt head *b* are adapted to slide in race-way *c* in the action body *d* whose forward part constitutes the breech piece *e* of the barrel *f* and is provided with the cartridge chamber *g*. The bolt-head is connected to the body, in the known manner, by a screw which admits of the independent angular movement of the body for locking and unlocking.

The extractor *h* is fitted within a groove or way *i* in the top of the bolt head *t*, and is covered up or enclosed by a solid hood or shield *j* which extends from end to end of the said bolt-head and comes above the extractor and the extractor-way, whilst when the parts are assembled, the rear ends of the extractor-way and hood are closed by abutting closely against the face of the forward end of the bolt-body.

This hood or covering may be made in the form of a hollow or arch-sectioned rib which is integral with the bolt head or the extractor-way and solid hood may be formed in a separate piece rigidly secured to the top of the bolt-head in any convenient manner, such as by dovetailing the base into the bolt-head and fixing it by screws or pins or otherwise. The hood or shield is so

arranged with respect to the extractor-way that it leaves sufficient clearance between its underside and the free or hooked end of the extractor as to admit of the latter having the necessary range of movement for engaging or snapping over the rim of a cartridge, but it nevertheless serves to prevent the said hooked end being raised too high or unduly levered out of the extractor-way by the force of the explosion in the event of a cartridge burst, and in this way, it obviates the risk of the extractor being broken.

As the hood or extractor cover projects, like a rib, above the reciprocating bolt-head, a groove or clearance *l* is provided within the crown or interior of the arched part of the action-body for the hood to work within during the movement of the bolt, and a similar recess or clearance is also formed in the face of the breech piece *e* to receive the front extremity of the extractor when the bolt is closed so that with the parts in the closed position, the forward end of the extractor hood abuts closely against the breech face, the extractor and extractor-way being completed boxed in or enclosed. No possible damage can occur due to the blowing back of the powder gases in the event of a cartridge burst.

A vent hole *n* is formed in the breech piece *e* to provide for a gas-way communication between the extractor recess that is formed in the face of the breech and the outside of the body, and further, the body may be bevelled at the front to allow gases to escape between the bolt head and barrel in a vertical direction.

The bolt head is guided in its rectilinear movement by a system of ribs or feathers *o* on its opposite sides engaging within grooves *p* in the sides of the bolt race-way of the body, or by some equivalent arrangement such as is described in Patent No. 1,000, 1907.

The extractor may be secured on the bolt head in any convenient manner preferably by means of a screw such as *q*. Accepted June 22, 1908.

THE SCHOVERLING SINGLE TRIGGER MECHANISM.

22,946 (1907). W. Fairweather, London. (Agent for *Schoverling, Daley and Gales, U.S.A.*) This single trigger mechanism for double barrelled guns is claimed to be absolutely "selective." A rocking piece brings the set of mechanism belonging to either barrel into action as required, and the gun may be discharged either left first and then right or *vice versa*, or either barrel only may be constantly used. Inertia is the means employed to obviate danger of double discharge through the involuntary pull, a part being left behind when recoil forces the gun back so that the part enters a notch in the limb through which the sears are lifted and prevents further movement of the trigger mechanism until the involuntary pull has passed.

Only the detail drawings of the mechanism are here reproduced. The reader will no doubt be able to grasp the arrangement and working of the parts from these.

The rocker *a* is responsible for holding the limbs *b* and *c* one in the operative and the other in the non-operative position. As is shown in Fig. 1 these limbs are pivoted at their lower ends to the rear parts of the links *d* and *e* which work on the same axis pin as does the trigger blade *f*. This axis pin passes through a slot in the front part of the bracket *g* secured as is shown to the trigger plate *h*. The top of the trigger blade *f* is slotted to receive the end of the limb *i* which works up and down in the slot *j* in the top of the bracket *g*.

It must be particularly noticed that the foot of the limb *b* is turned rearwards and the foot of limb *c* forwards. The right-angular arms *l* and *n* engage in the back and front bents of the rocker *a* and either one or other of these side arms is held immediately over the top of the plunger *i*.

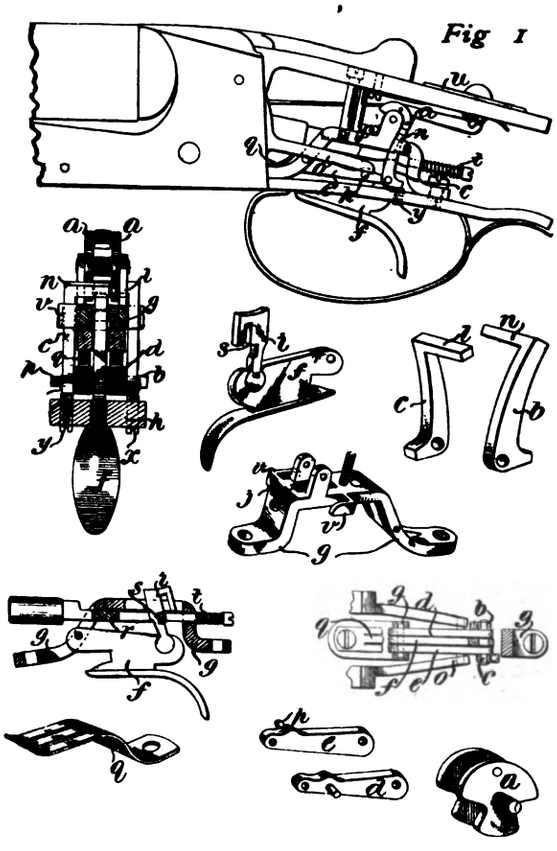
When the trigger is pulled the plunger *i* contacts with one of the arms and lifts one of the limbs bodily. The upward movement of say the limb *c* raises the rear end of the link *e* and so operates the sear *o* through the link projection *p*. Thus the left hand barrel is fired.

The continued upward movement of the limb *c* causes its arm *n* in the back bent of the rocker to move the rocker *a* forward on its pivot. This movement pushes the arm *n* off the top of the plunger *i* and permits the arm *l* of the right-hand limb *b* to be moved by one of the three arms of the spring *q* (through the medium of the link *d*) over the top of the plunger when it falls with the trigger. The parts are in this manner mechanically altered in position ready for the discharge of the right hand or second barrel.

The spring operated plunger *r* with its weighted end is the part through which the involuntary pull is rendered harmless. It works in holes in the bracket *g*. When the recoil of discharge forces the gun back against the shooter's shoulder the plunger stands still and its bevelled end enters the slot *s* in the plunger *i*, and so prevents either upward or downward movement of the trigger until the spring *t* has power to overcome the inertia and carry the plunger *r* backwards to its normal postion.

The rocking movement of the tumbler *a* carries the thumbpiece *u* on the action strap either backwards or forwards, and exposes either the letter R or the letter L corresponding with the barrel for which the parts are in position to fire. The parts may of course, be switched over from one barrel to another by manipulating this thumbpiece.

Fig 1



The angle pieces *v* on the bracket *g* and the pins *x* and *y* in the trigger plate guide and limit the rocking movement of the limbs *b* and *c*.

By means of a simple arrangement not illustrated here the parts may be automatically switched over to one particular barrel by the movement of the top lever when that limb is operated to break down the gun. A regular order of firing may thus be secured, *i.e.* right and then left or left and then right. Accepted June 18, 1908.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 192.—Vol. XVI. SEPTEMBER, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

The Shooting Season.—With the opening weeks of grouse shooting now passed, and partridge shooting on the point of commencing, it is necessary to admit that the bumper results everywhere anticipated, as a result of the favourable weather during June, have been discounted in various places by drought and disease. There seems to be no possibility of the season being pronounced bad, but there is a prospect that isolated instances where the head of game is below the normal will cancel the very successful areas, and so reduce the results of the season to an average level. The chief likelihood of the final result proving above the average rests upon the large number of instances where everything has gone well and large parties are being organised for dealing with a satisfactory head of game. The reports in the trade indicate that amongst sportsmen there is a decidedly greater show of keenness than has been evident for some seasons past in discussing purchases of guns and cartridges, and it generally happens that this evidence of interest denotes the receipt of satisfactory reports from the shooting quarters wherever these may be. The partridge will as usual decide how the season shall rank with reference to the past and future. The grouse reports show many ups and many downs, the net result of which seems to be that there is a fair amount of sport in all directions, with a prospect that the maturing of the second broods will keep the shooting going for some time to come. The rearing of pheasants is not subject in the same degree as with partridges and grouse to the inclemency of seasons; and so far as this year's weather conditions are concerned nearly everything has been favourable, and the birds seem to have been very healthy. Taking grouse and pheasants, therefore, as neither of them likely to show disappointing results in the aggregate, the partridge season seems likely to prove at least average, with a decided prospect of something better.

The Structure of Explosives Buildings. — Mr. Oscar Guttmann, who can always be relied upon to be interesting on whatever subject he may choose to talk, initiated a particularly attractive debate when he questioned the safety of existing methods of construction explosives buildings. The reprint of his lecture, delivered before the Society of Chemical Industries on July 15th last, contains a selection from the much larger number of illustrations of notable explosions, which were thrown upon the screen for the purpose of enabling the audience to appreciate the classification of destructive effects which explosions occasion. His general conclusion is that the present practice of making buildings of wooden framework and iron sheeting creates an undue tendency for weighty pieces of burning débris to be flung high into the air, pitching upon other buildings and so setting them alight and causing explosions. The alternative system of construction consists in the use of concrete, made up from a special kind of river-sand having physical qualities which cause it to break up under the stress of an explosion into small fragments insufficient in size to carry a serious distance through the air. The concrete would be reinforced with iron, and several other special devices would be adopted, all as specified in the lecture. The idea conveyed was that the present form of structure which has been

based on black powder requirements and conditions might with advantage be reconsidered now that explosives having entirely different characteristics are turned out. Whatever may be the practical verdict on the recommendations put forward by Mr. Guttman in his paper, valuable service has been done by emphasising the danger due to the ease with which pieces of wreckage become detached from the building of which they form part, and the vulnerability of buildings generally with regard to the same fragments in their descent.

The Explosives Report.——The report of H.M. Inspectors of Explosives, which has been issued during the past week, contains several items of exceptional interest. A *P.S.* note following the official section of the report, pays a generous tribute to the services of the late Capt. Thomson. His colleagues go into considerable detail in showing what exceptional qualities of mind their late chief possessed. The career of the late Dr. Dupré is similarly passed under review, and so far as is possible in a Government report due credit is given for his immensely valuable services and high scientific accomplishments. The report mentions that since his death, which occurred in July last year, the work of chemical advisors to the explosives department has been ably and efficiently carried out by his two sons, Percy Vivian Dupré and Frederick Harold Dupré. There are many who felt that the death of the father should have provided the opportunity for revising what the present report admits was in the case of the father a rather informal appointment. In practice the arrangement has worked well, except that manufacturers have at times felt that they were put to unnecessary expense in securing permission to proceed on obviously sound lines. The remedy would naturally lie in the direction of paying a specific salary to the chemical staff, rather than allow the earnings to depend upon the amount of fees received. The problem is purely of an administrative character, and even if a change cannot be made at the present juncture one source of satisfaction remains, viz., the undoubted capacity of the brothers Dupré and their ability to carry on with the zest of a younger generation the important technical work of which their father laid the foundations. Their report upon the mercury question constitutes a most valuable summary of present-day knowledge, with an addition of new facts which shows that research has steadily proceeded since the last public announcement of opinions was made.

Rifle Shooting at Unknown Distances.—The unlimited abuse which has been levelled at the Army Council because of their condemnation of bullseye shooting has distracted attention from the underlying truth which they were endeavouring to inculcate into the minds of those entrusted with the musketry instruction of the private soldier. At the recent Bisley Meeting a competition took place which consisted in calling up 60 high-grade rifle shots to estimate the range of a series of men presented to view in different parts of the surrounding landscape. The resulting guesses were so wild as to disentitle them to be regarded as serious estimates. A particular object, whose true distance from the point of observation might be 500 yards, would be guessed at 1,000 yards quite as frequently as 300 yards. The enormity of the errors made certainly suggests that skill in rifle shooting will be neutralised in a large number of instances by incapacity to measure distances. The Army Council appear to have gone astray solely in their attempt to find a remedy. If a target is presented to the shooter at an unknown distance, and his estimation of range varies from minus 50 per cent. to plus 100 per cent. it would be better that he should write down his answer than that he should fire a shot at the target, the inevitable miss giving him no information whatsoever, and, therefore, bringing him no nearer to efficiency. Amongst those who have had experience in training men to estimate distances it is commonly recognised that whilst the first attempts are ludicrously wide of the mark, a very little practice produces considerable improvement, so that in a short time the power of estimation is brought within reach of the accuracy of the rifle. The difficulty of obtaining rifle ranges where the targets can be situated in strange surroundings and at unknown distances would disappear if the shooting element were dispensed with. The competition would then merge into an excursion to some chosen spot, from which estimates would be made of the range of prominent points in the landscape, the true distances to be afterwards observed. If this interesting addition to rifle shooting practice was generally adopted, bullseye shooting would cease to be condemned because in doing one thing well it misses doing something else of an entirely different nature.

Price Maintenance in Sporting Cartridges.—The firm of Curtis's & Harvey, after consulting their many friends in the trade, have issued a circular laying down minimum selling prices for the whole of the sporting cartridges sold by them. The cartridges are not put forward as proprietary brands, the firm merely stating that the whole of the cartridges of their manufacture shall be assured a fair profit to the distributor. The policy involved in the decision which has been arrived at seems likely in the long run to prove the soundest and the most logical. The fixed minimum prices may not represent a large living when all the expenses to which the retailer is put are taken into account; but they have the merit of protecting the defenceless trader whose whole capital is invested in his business from extinction by a rival who endeavours at all costs to drive competitors out of the field. The ultimate success of price maintenance seems to be assured because the public sentiment is favourably disposed towards any system which guarantees a standard article at a fair price wherever it may be purchased. The mutual relations of wholesaler and retailer are likely to become closer as years go on. Each is dependent on the other, and the public is beginning to realise that the retailer who claims to rank as a manufacturer, thereby saving intermediate profits, is not always the benefactor he poses to be. Gunmakers, especially in the country, are watching present-day developments very closely, and they will not fail to show appreciation of a policy such as that of Messrs, Curtis's & Harvey, which goes the full distance of guaranteeing the minimum profit upon which the gunmaker can retain his position in the community.

CARTRIDGE LOADING.

NEITHER the gun trade nor ammunition makers seem quite decided in their own minds what constitutes good cartridge loading. They all know from experience the difference between good work and bad work, but very few are able to explain to the non-technical mind in true and convincing language the source of good quality. Some endeavour to catch the eye by introducing a special feature of no particular importance, such as a glazed card, a peculiarity of turnover, or an unusual texture of felt, and assert that the quality of the cartridge depends upon this special feature. Another set of arguments is based upon the belief, supposition or yarn, according to the point of view taken, that there is a vital difference between hand and machine loading, and that the former or the latter, according to who makes the statement, is vastly superior. A firm in a large way of business may make a great feature of their imposing array of chronographs, recoil guns, pressure guns and so forth, all of which are presumed to exercise a peculiarly beneficial effect upon the operations of the loading department. The gunmaker who loads only with standardised powders, and adopts the instructions of the powder maker, shifts the burden of taking pressure and velocity to the very capable shoulders of the man who makes the powder. Modern nitro-powders mostly depend for their sale upon purchases in bulk by loaders in a large and a small way of business, and they are sold upon the reputation they have attained as highly standardised materials. In such instances there is seldom any attempt to shirk the resulting responsibility should it be clearly shown that for once in a way a deviation from the usual high quality has occurred. The alternative system of loading, which involves the use of testing instruments, consists in aiming at a higher degree of perfection than ordinary by taking a powder made as well as it can be made in the first place, and then endeavouring to ascertain its special proclivities, these being modified by alterations of load. Provided the powder so treated is made in sufficiently large batches, and also provided that the opportunities of subsequent adjustment are not made an excuse for shirking the work of standardisation, the humouring of powders by the adjustment of loads and wadding is theoretically not bad in principle. In practice it suffers from the disadvantage that the checks put upon manufacture when a standardised article is required are apt to be ignored when the powder can be used unstandardised.

An example of what is meant was provided by a foreign powder which some years ago caused a gun to burst, personal injuries being sustained which resulted in a claim for damages. The solicitor entrusted with meeting these claims was informed that the ground work of his defence should be that the powder was made to an unvarying standard of quality, that the charges were checked with the most perfect apparatus it was possible to procure, and that the accident or accidents which had been said to result from the use of the powder must have been caused by unfair treatment in storage, or by the use of inferior weapons. The solicitor was wise enough to take the precaution of having an independent test of the cartridges made, and it was at once reported that they contained an overcharge of an unusually violent sample of powder. These facts being reported to head-quarters it was then admitted that the cartridges did belong to a batch made from weak powder, the strength of which was brought to standard by the use of a slight overcharge. Further investigation made it clear that the first weakness was the result of unevaporated solvents remaining in the powder, and that when these had dissipated in the course of ordinary storage the powder took up its natural behaviour, which happened by bad luck to be on the violent side. When a powder is used in a completely standardised form, each sample as a rule comprises blendings from many batches. The result is in the nature of an average, skill in manufacture consisting in making each batch deviate but slightly from the ideal or average specification. One of the chief difficulties in powder making is to ensure the unvarying maintenance of the three-dram bulk for the particular number of grains that constitute the standard charge. When this bulk is assured and the powder grains are sufficiently rigid to resist compression beyond a certain point, the cartridge loader can insert the usual wads and shot charge with every assurance that the turnover will be of the right size and uniform in shape. To summarise this long divergence on the subject of standardised powders it may be said that the cartridge loader who adheres to the well-known powders can view with an easy conscience the absence at his shooting ground of chronographs and pressure guns. On the other hand if the gunmaker wisely decides to associate the highest quality loading with the adoption of standard methods and charges he must abstain from claiming for his output the possession of mystical qualities of excellence.

It is no compliment to the intelligence of the sportsman to suggest that nobody knows the right load for a gun except the gunmaker who makes it. Gunmaking is an entirely different branch of manufacture from cartridge and powder making. Therefore, whilst one looks for mechanical excellence in the gun, the qualities demanded in a cartridge are based more upon appreciation of physical and chemical problems than the arts of iron and steel craftsmanship. The gunmaker is beyond all things a mechanic, and the perfection of his workmanship is a source of wonder even to the highly trained mechanical engineer. The gun and the cartridge enjoy a common meeting ground in the boring of the barrel, and the gunmaker must naturally depend upon a supply of cartridges of standard excellence and uniformity for testing the performance of his weapon. If he is scientifically inclined, and willing to take a large amount of trouble to secure the best results, he will himself load the cartridges used in testing, so as to check the regularity of the charges and otherwise avoid the irregularities inseparable from a commercial brand of cartridge. All these things it is in the power of the gunmaker to carry out for himself, but it is no help to him in his business to suggest that he can discover new combinations and dodges imparting new virtues to the powder which even the powder maker cannot emulate by alterations of manufacture.

THE PERRANPORTH LICENCE.

AT Truro on the 27th ult. Major H. Cooper-Key, chief inspector of explosives, held an inquiry into the application by Nobel's Explosives Co., Ld., for the amendment of their license to store an increased quantity of cordite at Perranporth. As reported in last month's issue the West Powder Magistrates, as the local authority, refused their assent to the application. Messrs. Nobel appealed to the Home Office, hence the inquiry just held.

Mr. Robert Dobell, on behalf of the objectors, urged that the presence of the factory at Perranporth had greatly deterred the development of the place. The witnesses who gave evidence before the West Powder Bench were called, and examined as the Inspector desired.

John Frederick Healy, of Perranporth, was a fresh witness. Speaking of the explosion at the works in 1902, he said he was in his shop at the time of its occurrence; the place was shaken and bottles were thrown from the shelves. To the lay mind the greater the amount of explosives stored the greater the amount of danger.

The Inspector: Would you be glad or sorry if the Factory was removed altogether? Witness: I should be glad to see the whole factory go. As it stands at present it is a great drawback to the development of Perranporth, one of the finest watering-places in the county.

Mr. Sitwell, for the landowners he represented, pointed out that under the Explosives Act a license expired, if for a period of two years the licensees failed to carry on the business for which they were licensed. He contended that the present was practically an application for a new license. The Inspector said that in whatever recommendation he made to the Home Office this point should not be lost sight of.

Mr. Gow (agent to Lord Falmouth) said the presence of the factory had retarded the development of Perranporth. Had the factory not been there the place would have been one of the most thriving seaside resorts in the county.

Mr. Hamilton (agent to Mr. J. D. Emys) said that last week a lady had enquired of him for building sites at Perranporth, but on hearing that there were explosive works in the district she said she would have nothing further to do with the matter.

For Nobel's Explosives Company, Mr. Rogers, chemist in their employ, said it would be much less dangerous to store cordite than to carry on the manufacture of explosives. At present it did not pay them to manufacture at Perranporth, and they desired to make use of the buildings. They accordingly applied for this license to store. Some of the cordite they had on hand was the result of the War Office making their test more stringent at short notice. In other instances they had manufactured more than they required of certain sizes and desired to keep the stock till it was wanted rather than re-work it.

Major Cooper-Key said that what might not pass the War Office test might be absolutely and perfectly safe for storage in this country, and pass the Home Office test. He did not think the question of increased danger came in.

Mr. Nalder said the factory was originally started with the desire of the inhabitants, and the company had spent something like £200,000, of which £100,000 had gone in labour for the benefit of the people of the locality. They now came forward and asked, because this company was going to stop manufacture, and would not be spending so much money, and because they were not going to get so much out of it in the future, although it was proved up to the hilt that the danger would immeasurably less than it was under the old, that the inspector should put his foot down on this application. As to the refusal of the magistrates to assent to the license, Mr. Malder remarked that the justices advanced no reason for doing so, and observed that it might be said of them

> I don't like you, friend Nobel,
> The reason why I cannot tell.

Mr. Dobell said that there was a widespread sentiment abroad that if this huge quantity of cordite was to be stored there it would be a considerable danger to the locality. It would, he submitted, be altogether wrong for the Secretary of State to grant the license after the local authority had come to the conclusion that it would be to the general disadvantage of the interest of the neighbourhood to grant the license. The Inspector said he had all the information he desired in order to advise the Secretary of State, and the decision would be known in due course.

GUN-COTTON IN SCOTLAND (1847).

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

Schönbein in his account of the steps leading to the discovery of Gun-cotton (*Arms and Explosives*, July, 1908), and the special work done upon this subject mentions the name of Walter Crum as showing that gun-cotton was quite different to the nitro-starch discovery by Braconnot and further investigated by Pelouze.

Crum's paper is contained in the *Proc. Phil. Soc. Glasgow*, Vol. 2, page 163, 1847. His work is of very particular interest, not only on account of his thorough chemical investigation of gun-cotton, but also from the point of view that he devised the method which is now in universal use for the estimation of nitrates, nitric acid and gun-cotton—the nitrometer. The original chemical notation is retained in this account of his paper, and, if it be borne in mind that the atomic weight of oxygen in Crum's time was taken as ·8 and that the formula for nitre was KO. NO_5, the figures in his paper can be very readily followed.

"At the first meeting of the present session of this Society I gave an account of some experimental enquiries into the nature of gun-cotton, a body whose composition was then little known. I had at that time chiefly occupied myself with its nitrous contents, and described a method by which some approximation could be made to a quantitative result for nitric acid. On resuming the subject I find that much was wanting to render the method a rigorously accurate one, and I shall now relate what I have since done to simplify and complete it. I shall first, however, give an account of its application to potassium nitrate, a body of known composition and easily obtained in a state of purity, to which I have

had recourse as a means of proving the accuracy of the method and detecting any fallacy to which it might be liable.

Nitric Acid in Potassium Nitrate.

Purified by repeated crystallisation and fused at a little more than its melting point. A glass jar 8ins. long and 1¼in. in diameter is filled with and inverted over mercury. A single lump of fused nitrate weighing about 6 grains is first let up into it, and afterwards 50 grains of water. As soon as it is dissolved, sulphuric acid (125 grains), ascertained to be free from nitric acid are added. By the action of the mercury on the liberated nitric acid, deutoxide of nitrogen soon begins to be evolved and usually in about two hours, without the application of heat, the whole of the nitric acid is converted into that gas. Occasionally agitation is necessary and it is easily performed by giving a jerking horizontal motion to the upper part of the jar. The surface of the sulphuric acid is then marked, and ¾ of a cubic inch of a solution of ferrous sulphate, recently boiled, is let up into the jar. The gas is rapidly absorbed, except a small portion at last which must be left several hours to the action of the solution, or be well shaken in a smaller tube with a fresh portion of it. No correction of deutoxide of nitrogen has to be made for moisture, for the mixture of the acid and water which I employed, and as I ascertained by direct experiment, has not perceptible force of vapour.

First experiment.

5·4 grains of potassium nitrate yielded 4·975 cubic inches of gas at 60°F. and 30 inches. The residue not absorbed by ferrous sulphate equals 0·015 cubic inches, leaving 4·96 cubic inches of deutoxide of nitrogen which is equal to 1·594 grains of NO_2 and which corresponds to 2·869 grains of nitric acid or 53·13% of potassium nitrate. Four consecutive experiments gave

53·13
53·14
53·73
53·29 mean 53·32.

The calculated percentage of nitric acid in nitre, the acid being taken at 6·75 and the potash at 5·8992, is 53·36. In order, further, to determine whether the presence of organic matter would interfere with the liberation of deutoxide of nitrogen, the experiment was repeated with the addition of 3 grains of cotton wool which was dissolved in the sulphuric acid. The result was 53·24. Other nitrates were analysed in the same manner. For salts in powder which it is difficult to pass through the mercury without loss, I cut a ¼-in. glass tube into little cylinders of about ½in. long and closed up at the ends with thin paper fastened with gum. In the analysis of numerous samples of crude nitrates the residue, which is azote, may be taken as a constant quantity, and the jar graduated in such a manner that the volume of gas may be read off at once as percentage of nitric acid.

Preparation of Gun-cotton.

The cotton I used was fine "Sea Island." It was first thoroughly carded and then bleached by boiling in caustic soda and put in a solution of bleaching powder; then caustic soda again, and afterwards weak nitric acid. It was well washed and beaten in a bag with water after each operation. When burnt 10,000 parts left 9 of ashes. It was considered to be lignin nearly pure. The cotton dried and carded after bleaching was exposed in parcels of 10 grains each for several hours to the heat of a steam bath and each parcel was immersed, while hot, into a 1oz. measure of the following mixture: Sulphuric Acid, 1 measure (1·84), and 3 measures of pale lemon coloured nitric acid (1·517).

After one hour it was washed in successive portions of water until no trace of acid remained and then dried in the open air. 30 grains of bleached cotton waste dried at 65°F. became after some hours in the steam bath 28·32 grains and lost therefore 5·6% of water. It increased to 51·08 grains when made into gun-cotton and dried in the open air. Dried further in a vacuum over sulphuric acid it was reduced to 50·40 grains and lost therefore 1·33% of water.

100 parts of dry cotton waste produced 177·9 parts of dry gun-cotton. Gun-cotton thus prepared is whiter but less transparent than the original bleached wool. It appears to be little liable to change but a slight elevation of temperature causes a commencement of decomposition and the colour becomes more or less brown. It is much less tenacious than cotton wool. Dissolved in nitric acid and tested with barium chloride it gives no indication of sulphuric acid. The increase of weight above stated is the greatest I have been able to obtain, and I had completed its analysis in the manner I shall describe, when I found occasion to believe that it still contained a portion of unaltered cotton. With a view to saturate that portion it was immersed a second time for 24 hours in the same mixture of acid but without yielding any greater quantity of nitric acid. An immersion of one hour in nitric acid gave a better result. It lost in weight by this second process 0·47%, but was little altered in appearance, but after being dried in the open air it lost in the air pump only 0·69% instead of 1·33% as in the former case. It is this substance of which I will now relate the analysis.

Ashes in Gun-cotton.

16 grains of gun-cotton were dissolved in nitric acid. The solution evaporated by degrees and burnt to ashes left 0·035 grains of a reddish ash = 0·22%.

Nitric acid in Guncotton.

In this process the same apparatus was employed as for potassium nitrate. About 6 grains of guncotton, containing a known quantity of water, is collected into a ball and squeezed between the finger and thumb to free it as much as possible from air and let up into the jar over the mercury trough. 125 grains of sulphuric acid were added to it. Nitric acid is liberated, and after being acted on by the mercury produces oxide of nitrogen. After one hour when about ¾ of the whole gas has been evolved and the guncotton is entirely dissolved 50 grains of water are added. In another hour increase of gas ceases. In a few hours more its boundary is noted. It is then treated with ferrous sulphate solution and re-measured. The residue consists of azote from the common air introduced with the guncotton and a minute portion also which is always entangled between the mercury and the glass. Its oxygen is absorbed by the mercury when in the state of nitrous acid.

First Experiment.

6·02 grains of guncotton = 5·978 dried in a vacuum over sulphuric acid = 5·946 grains after deducting the ashes, gave

5·513 cubic inches of gas at 30 inches and 60°F. of which 0·08 cubic inches were left by the ferrous sulphate. This represents therefore 5·433 cubic inches of deutoxide of nitrogen = 1·746 NO_2 which represents 3·143 grains of nitric acid = 52·70%. The second experiment gave 52·68% Guncotton, prepared by a single immersion, gave only 51·24 % of nitric acid.

Carbon in Guncotton.

Having failed to obtain good results by burning this substance with copper oxide I used chromate of lead prepared from the nitrate and heated to redness. I employed for the combustion an apparatus which I used many years ago for the analysis of indigo, and I still find it very convenient for substances such as do not require a strong red heat. It consists of a tube of hard glass 8ins. long and ⅜in. in diameter, the gases from which are led by a small bent tube under the receiver in a mercury trough. One inch of the closed end of the tube is filled with 8 grains of chlorate ground with lead chromate ; 4½in. is filled with lead chromate among which is ground to powder three grains of guncotton ; 1½in. contains lead chromate used to wash out the mortar. A glass plug separates these materials from the perforated cork which joins the two tubes. The materials are gradually heated with a broad wicked spirit lamp. Carbon di-oxide comes over mixed, when, in the receiver, with NO_2, and the azote of the apparatus, and when all the guncotton is consumed the lamps are extended to the chlorate. The oxygen gas thus liberated, which, in other cases is useful to consume carbonaceous matter that may have escaped the chromate, expels in this case all remains of carbon-di-oxide, and passing itself into the receiver, mixes there with NO_2 and causes its entire absorption by mercury. Oxygen and azote are then the only gases left with carbon-di-oxide, and, as they are not absorbable, an addition of ½ cubic inch of caustic soda indicates exactly the quantity of carbon-di-oxide present. In one experiment 2·993 grains of guncotton (after deducting water and ashes) yielded 7·972 cubic inches of gas of which 5·733 were carbon-di-oxide = 0·739 grains of carbon or 24·69%. A second estimation gave 23·16 Mean = 24·92%.

Elements of water in Guncotton.

To burn guncotton for the purpose of collecting its oxygen and hydrogen in a state of water, I ground up 10 grains with powdered flint, and used the combustion tube already described, having attached to it a calcium chloride tube, and afterwards a tube with asbestos moistened with sulphuric acid. But, along with the water, ammonia and other matters were obtained which destroyed the result. I next used a thin glass tube of 1½inches long bent so that one inch in the middle would dip into cold water. Such water as would condense at 65°F. was collected. The water was led through it into a mercurial trough and measured.

A trace of cyanogen appeared in the last portion of the gas, while the oxygen from the chlorate was burning a quantity of carbon that had escaped the nitric acid. After the experiments the refrigerating tube was found studded with crystals of bi-carbonate of ammonia. It contained very little water in the liquid state. The crystals and liquid were washed out with water, converted into muriate of ammonia and were found to contain 0·675 grains of ammonium carbonate, the hydrogen of which represents 0·299 grains of water. There was besides 2·025 grains of water in the tube ; and in the 22 inches of gas which were obtained, assuming it to be saturated with moisture, which is doubtful, there was 0·088 grains, making in all 2·412 grains from which must be deducted 0·160 grains hygrometric water in the guncotton and flint, leaving 2·25 grains for the water in 9·92 grains of dry guncotton or 22·7%. In a second experiment where the only difference was in having moistened cotton for the gas to pass through before entering the mercury trough, the water obtained only amounted to 20·61%. I did not proceed further. These were the two last of a number of experiments, and the determination of nitric acid and carbon are so much more satisfactory that I prefer resting the water content on this result. The experiments I have related give the following for the composition of guncotton.

52·69	nitric acid
24·92	carbon
22·39	water
100·	

These numbers are nearly in the proportion of 12 C, 7 HO, 3 NO_5.

Found	Calculated.
52·69	52·69 = 3 NO 5
24·92	23·41 = 12 C.
22·39	20·49 = 7 HO.
100·	96·59

Leaving a remainder of 3·41% consisting of 1·51% carbon and 1·9 % water. These, however, are nearly in the proportion which form lignin.

Found.	Calculated.
1·51	1·51 = 12 C.
1·90	1·88 = 10 HO = Lignin.

Guncotton, from the form in which it is produced, is not one of those substances we can expect to obtain in absolute purity. Every previous improvement in its preparation had diminished the excess of unaltered cotton, and I have no reason to suppose the last portion perfect, considering the difficulty with which some of the previous stages of improvement have been attained. The specimen I have thus examined consists therefore of

96·59	guncotton
3.41	lignin
100·	

And pure guncotton consists of

24·24 = 12 C.	24·24 = 12 C.
21·21 = 7 HO.	2·36 = 7 H.
54·55 = 3 NO.	14·14 = 3N.
	59·26 = 220
100·	100·

It is lignin in which three atoms of water are replaced by three atoms of nitric acid.

(Considering the method of preparation of Crum's cotton and the apparatus at his disposal the figure which he gives for nitric acid, which is equivalent to 13·69% of nitrogen, speaks volumes for the accuracy of his work and methods).

ROUND THE TRADE.

The firm of Orbea & Co., of Eibar, Spain, have forwarded to this office a copy of their catalogue of revolvers, the same showing a wonderfully varied selection of models, admittedly based upon Smith and Wesson design.

Under the name Charles Lancaster and Co., Ld., a company with a capital of £12,000 has been registered to take over the gunmaking business of the same name and as carried on for so many years by Mr. H. A. A. Thorn. The premises are, as is well known, situated at 11 Panton Street, Haymarket, and that the arrangement is purely of a private nature and involves no change of personality is shown by the circumstance that Mr. Thorn is acting as managing director.

The contract negotiated by Mr. F. Marten Hale and provisionally signed in London in March last by the President of the Chilian Naval Commission, appointing the Cotton Powder Co., Ld. official manufacturers of Cordite for a period of six years, 1908 to 1913, with a fixed minimum supply each year has been ratified by the Chilian Government. It is the intention of the Government to replace the whole of their existing stores of Mark 1 Cordite with the new M.D. composition.

Steelite Explosives Ld. is the name of a company which has been registered with £100,000 capital to acquire certain patent rights, etc., the first directors being Professor Galloway, of Cardiff, Mr. A. M. Joshua of London, Mr. M. Muspratt of Liverpool, and Sir William Taylor of London. A quarter of the above capital has been offered for subscription, the Company acquiring two leasehold factories situated at Widnes, near Liverpool and Penrhyn-Deudraeth, near Portmadoc, North Wales.

According to newspaper reports Engineer-Commander Clarkson, of the Commonwealth Naval Forces, has been sent to this country for the purpose of acting as agent at this end for the purchase of machinery and other requirements in connection with the small arms factory which it is proposed to establish at Lithgow in New South Wales. The seat of the new industry will thus be about 100 miles inland from Sydney, the half-way town being Penrith, a name which certainly harmonises with the idea of ironworks and industry generally.

The Sporting Goods Review loading card for nitro-compounds has been issued during the past month, and it gives the usual well digested information concerning the various smokeless powders now on the market. The charges for each size of cartridge continue to be shown in the manner which enables the load recommended for one powder to be compared with the same particulars relating to another. The only new powder of any importance is cube Schultze, 30 grains of which occupies the three-dram bulk, and constitutes the standard 12-bore charge.

The Birmingham Small Arms Co. have decided after a two-years' experience of a 48-hours week to revert to the old programme. The factory was originally worked on the 53-hours system with two breaks daily, but in November, 1906, it was decided as an experiment to reduce the hours to 48 with only one break for dinner each day. It was thought that the company would be compensated for the shorter working hours by the avoidance of the loss of time immediately before and after the breakfast interval and by the increased energy it was believed the men would put into their work. It has been found, however, that the expectations have not been realized; hence the decision to revert to the old system. Careful inquiries show that the majority of firms in the same line of business work from 52 to 55 hours a week with two breaks, and in some cases only one break in the day for meals. About 3,000 men will be affected by the change. The decision to increase the working hours by five a week has created much dissatisfaction, although the usual hours in the engineering trade in the district are 53.

From the New Explosives Company a very neat calendar, covering the shooter's year from July to July, has just been received. "The Three of Us" illustrations are duly reproduced, the said three being Neonite, Red Star and Felixite, though the idea is carried further by three grouse and three powder tins.

The British Westfalite Company, whose factory is at Denaby, Rotherham, Yorkshire, have forwarded a pamphlet relating to the permitted explosive "Westfalite." Though this explosive was originally introduced from abroad, the only non-English part about it now is the name. It is made in two compositions, No. 1 being slow burning to suit soft coal, the more powerful No. 2 being adapted for dealing with more resistant material. The catalogue is well printed and well illustrated, the series of instructions being brief and easy to grasp.

Gunmakers are understood to echo with heartfelt sincerity the following reply which was given to a correspondent in a recent issue of *The Field*:—"Gambia." There is nothing improbable in the fact of an action being badly strained in the course of five years' use, much of it in a hot climate. Whether the gun was of reasonably good design cannot be settled without examination, but sportsmen are apt to forget that, weight for load, the gun is the most heavily worked mechanical structure in the world; yet the moment anything goes wrong the user immediately assumes indifferent workmanship.

Constant references are now appearing in the general press to the effect that gun running on a particularly large and daring scale is proceeding between certain Persian coast towns and the interior of Afghanistan where the goods command a ready sale. The class of arm said to be passing through in this manner are modern in the sense that they are breech loaders, and include such rifles as Martinis and even magazine arms, the date and quality varying mainly with the price which the purchaser is prepared to pay. It has been suggested that the only way to stop the traffic would be for Britain to pay the Sultan of Muskat a subsidy equal to the amount he now receives by way of dues for the goods passing through the ports under his control.

Particulars of the new import duties for the Commonwealth of Australia have now reached this country, and the tariff on goods originating from the United Kingdom is an amount varying in the neighbourhood of two-thirds to three-quarters that levied on goods coming from other countries. Whether the result will be an increase of trade is very doubtful in the case of goods upon which a heavy duty is put in place of the free imports previously current. The expected penalization of arms not proved at a public proof house will be very gradually expired, so much so in fact that the marking of the word "tested" by the manufacturer, coupled with certain conditions will be accepted for the time being as sufficient guarantee of security.

The Ideal Manufacturing Company of U.S.A. have issued a leaflet illustrating a large series of bullets for reloading high-power rifle cartridges. The bullets are used in combination with a metallic base, which is described as patented although in point of fact the device dates a good deal subsequently to Kynoch's metal base, and it is well known that this latter firm abandoned their claims when it was pointed out to them that Eley Bros. had made the same kind of thing some 20 years earlier. The metal gas check satisfactorily overcame the difficulty, which was experienced when smokeless powders were first introduced, of making them work with lead, as distinguished from metal-jacketted bullets. Great as was the ingenuity expended in efforts to arrive at a cheaper solution, by way of a hard composition of white metals, the metal base has proved triumphant. The only distinction now separating the American practice from our own is that our neighbours leave the metal base loosely attached to the bullet, whereas in this country it is considered desirable to make a solid fastening.

MODERN RIFLE BALLISTICS.

IT is becoming more and more necessary to view recent changes in rifle ballistics with a clear sense of perspective based on knowledge of the most recent developments. Up till about three years ago the ideal in high power rifles was a jacketted lead bullet rather more than an inch long with the conventional blunt shaped nose which the text books described as ogival or hemispheroidal, thereby effectively checking further enquiry by the student. According to the official small arm text book of 1894 "practically it is always found that the resistance of the air is more affected by the slope of the surface joining the head and the body (which should be as gentle as possible), than by the sharpness or bluntness of the actual point." This constituted the state of knowledge up to practically December 1905 when the particulars of the Spitzer bullet were first published in this country and received serious attention. That earlier publication took place is proved by the circumstance that the Spitzer bullet formed the subject of patent No. 3,429 (1905). The specification of this patent was published about the first week in May of the same year. This journal summarised the epoch-making patent in the following terms:— "Investigations by electric spark photography have enabled the patentees to solve the question as to the most favourable form of projectile head for high velocities. The head is equal to about half the total length of the projectile and is curved to a radius equal to from four times to nine times the calibre. The length of the cylindrical or guiding portion of the bullet is made equal to 1·85 times the calibre; the length of the head (*i.e.*, from the point at which the diameter begins to decrease to the tip of the nose) equal to 2·19 times the calibre; and the mean radius of curvature of the pointed head 4·7 to 8·2 times the calibre. Deutsche Waffen und Munitionsfabriken, Germany." The descriptive matter of the patent would even now be described as doing the right thing for the wrong reason. Hence it may be accepted as a fact that the Spitzer discovery could only be distinguished from other freaks of invention by overwhelming practical proof. This being forthcoming in due course developments have proceeded so rapidly that it is necessary to review progress from time to time in order to ensure a proper arrangement of ideas on the subject.

The probable early introduction of a pointed ·303 service cartridge gives the matter a double interest, and once more raises the question why sporting rifle manufacturers have been so slow in taking up with the new fashion. The effect of pointing the nose of a bullet is to diminish the resistance encountered in passing through the air, thereby giving the projectile a greater remaining velocity at all ranges. Flatness of trajectory is a desirable adjunct for all rifles, but the sporting rifle is distinguished from the military arm by the fact that the former requires to show a flat trajectory over but 300 or so yards of range, whilst with the latter there is no limit to the range at which practical results are required. With the sporting rifle, a greater margin for increasing flatness of trajectory is provided by the possibility of raising the muzzle velocity than by adopting the relatively slight improvement which a better shaped point introduces. The sharpened point proves upon experience to give unsatisfactory shock effects on game, and it is less easy, by modifications of the nose, to produce the requisite degree of expansion upon impact than is the case with the older alternative form of bullet.

From the point of view of sporting rifles the disadvantages of lessening the shock giving properties of the bullet outweigh the benefit of a flatter trajectory arrived at by means which diminish the difference between striking and muzzle velocity. With the military rifle on the other hand practical considerations necessitate safeguarding the efficiency of the bullet at extreme ranges. Hence the importance of an invention which preserves intact a large proportion of the energy which was previously dissipated in overcoming air resistance. By just as much as the results at the further ranges are improved so the shorter ranges can receive a share of extra attention by way of exchanging a certain amount of bullet weight for extra velocity. Precise quantities can necessarily only to be determined by an examination of actual conditions, the terms of the compromise being set out in the form of comparative tables of trajectory denoting the behaviour of the various combinations under consideration. The justification, be it remembered, of this tinkering with the constitution of the cartridge is the unexpected advantage in trajectory which was gained by the introduction of the improved shape of bullet. If this improvement of shape were introduced without altering the weight, velocity, or other details of a cartridge, the benefit arising would naturally be most apparent at the further ranges. In other words whilst an improvement would exist at 100 as well as at 1,000 yards the advantage at the shorter distance would be relatively very slight, whilst at the further distances it would be relatively very large. The pointing of the bullet unaccompanied by other changes thus upsets the old balance of opposing requirements as carried out in the military arm. The efficiency would accordingly be less than in an alternative scheme, where other changes were introduced to give an equal gain all along the line. This process of equalisation has taken the form of lessening the weight of the bullet with a view to enhancing the muzzle velocity. The destruction of efficiency at the further ranges which such a course would ordinarily entail is neutralised under the new conditions by the improved shape of the bullet.

This process of modification can be carried to certain lengths with any existing rifle, but practical conditions determine the useful limits. For instance, it seems reasonable to suppose that for sporting use the introduction of the sharp nose will be discounted and to some extent discouraged by the exceptional difficulties of giving to bullets so shaped the power of mushrooming upon impact. With the British service rifle the disadvantage of the weak breech action will naturally rise to the mind, but this occupies a slightly different position. The breech action of the rifle is certainly weak, and the cartridges to be fired therefrom must necessarily be of lower total power than the cartridges fired

from service rifles of greater strength ; but this disadvantage is relative and it already exists between the present service cartridge and the non-pointed cartridges of other nations. The difference will be apparent to the same extent when pointed cartridges are compared on the same basis. In a similar fashion the ·303 cartridge case is of inadequate capacity to contain the amount of powder necessary for effectively propelling the bullet. Furthermore, the head of the cartridge with the large cap and the small amount of metal in the base similarly sets a limit on the amount of energy that can be extracted.

All, or at any rate most of these points are factors which cannot be evaded in the problem of adaptation. The best result would naturally be obtainable where the liberty existed to adopt a new rifle, a new cartridge, and if necessary a new calibre of barrel. That the full programme would produce superior results need not detract from the important advantages which will accrue from doing the best possible with the materials at present available. These include a rifle firing a cartridge capable of imparting 2,100 f.s. muzzle velocity to a 215-grain bullet using ordinary cordite, still higher results being attainable with M.D. cordite. Bisley records show that the service rifle can be safely used in this climate with a 225-grain bullet, and a muzzle velocity in the region of 2,300 f.s. To what extent these limits should be reduced to give an adequate margin of safety to cover use in hot climates cannot be stated off-hand, but there is a moral certainly that whatever may be the limits enforced by existing construction, a cartridge vastly superior to the existing one may at once be adopted without introducing structural changes in the rifle.

The pointing of the bullet nose would produce improved results at the distant ranges which would justify reducing the weight of the bullet to 175 or 180 grains, thereby increasing the velocity between 300 and 400 f.s. above the present standard. This would give a considerable increase of flatness at the shorter ranges, the sharp point preventing any deficiency occurring further away. The particular advantage about the lessened weight of bullet is that it enables the length of the existing bullet to be retained, thereby complying with the necessity that the cartridges shall fit the magazine. The loss of weight is thus represented by the substance removed in pointing the nose.

From the point of view of sporting rifle cartridges it will be apparent that when short distances alone are in question the improvement of velocity resulting from an alternative shape of nose is relatively small compared with the change which can be effected by using a diminished weight of bullet in combination with a correspondingly modified powder charge. The improved shape of point might of course be super-added to any advantages which could be gained by readjusting the weight of the bullet, but practical conditions will alone determine in what rifles the pointed nose gives a definite advantage, bearing in mind the important question of expansion. It is evident, upon looking closely into the question, that the future improvement of high-power sporting cartridges depends mainly upon the necessity to set right an omission which occurred when this series of cartridges was first designed. The most suitable propellant available at the time was cordite, and to avoid difficulties the bullet density of all these cartridges was made identical with that of the service ·303. Bullets of less weight were freely catalogued and supplied, but the official cartridge for each rifle was the one which reproduced ·303 conditions, and the fixed sights on the sporting rifles for which the cartridges were intended discouraged changes of ammunition of a kind likely to affect the jump of the rifle.

The most notable effect, therefore, of the recent changes in the military rifle is to call attention to the circumstance that gunmakers have not up to date made use of the possibilities of flattening trajectory, which the introduction of high power rifles rendered possible. Whether it will be worth while to make changes in the larger bores is very doubtful indeed, because these weapons are as a rule fired at such close quarters that the trajectory is already flat enough, and the large weight of the bullet guarantees a useful margin of surplus strength. With the lighter rifles used on horned game the distances are such that every possible means of flattening trajectory is bound to be utilized sooner or later. A diminution of the density of the bullet will give the opportunity of materially enhancing velocity, but calculation and experiment working in combination must determine whether the balance of advantage lies in the direction of adopting the pointed shape in part or in whole.

Meantime the change in military rifles is proceeding apace. It is confidently asserted in all well-informed quarters that the best calibre for giving full effect to the new conditions is 7 millimetres, in other words in the neighbourhood of the ·280 calibre of the Ross rifle. The Spitzer cartridge is associated with the 7 mm. Mauser rifle, and the muzzle velocity imparted to a 138·5-grain bullet very nearly approaches 3,000 f.s. The British service rifle with a modified cartridge having a 180-grain bullet, and a 2,400 to 2,500 f.s. velocity ranks far behind it in military utility. It is difficult to see how the apparently necessary velocity of 3,000 f.s. can be obtained with the ·303 rifle without reducing the weight of bullet to an absurdly low level, such as would show defective results at long ranges. The 150 grains of the Ross bullet, or the 140-grains of the Mauser, are about equivalent in density to 180 grains in ·303 calibre. To obtain a trajectory equivalent to that of either of the cartridges mentioned the velocity would need to be raised to the neighbourhood of the 3,000 f.s. already mentioned. The large size of cartridge case necessary to hold the powder charge to produce such a result and the necessity to keep down pressure are not the only difficulties. Recoil equivalent to present conditions would be established with a velocity of 2,500 f.s., and the large excess introduced by a further rise of 400 to 500 f.s. would be noticeable to the shooter, especially if he used one of the light weight rifles. The present situation may, therefore, be summarised by saying that a half measure of improvement can at once be made available by introducing a new ·303 cartridge with a reduced weight bullet having a pointed nose ; but up to date conditions cannot be realised except with a new rifle having a properly constructed breech and a calibre in the neighbourhood of ·280 inch. This, at any rate, is the view held by those whose opinion is backed by sound technical knowledge.

THE ANNUAL REPORT ON EXPLOSIVES.

THIS report deals on the first page with the death of Dr. Dupré during the year under review, and then follows a summary of the incidents of a career full of useful work, at times carried out under conditions of personal danger. The chemical work of the department, which has been carried on by the sons of the late doctor, has been exceptionally heavy during the year. The total number of samples examined amounts to 559, in addition to which there were carried out 155 tests for the presence of volatile mercury salts, and 72 special heat tests for the investigation of the effects produced by mercury on the heat test. Whilst dealing with this important subject the following full text of the brothers Dupré's remarks thereon may be introduced :—

TESTS FOR MERCURY.

In our annual report for 1906 we stated that methods for testing various kinds of explosives for mercury, or volatile mercury salts, were being worked out, and that details of those methods finally adopted would appear in this year's report. Various methods had to be worked out, as different classes of explosives require quite different treatment, and in some cases specially delicate methods had to be employed when the quantity of mercury present was extremely small, although still enough materially to affect the heat test. In all cases a special form of spectrum tube was employed, and this will be described first. The apparatus consisted of two stoppered tubes of about 20 cc. capacity, joined by a capillary tube. To one stopper was attached a tube fitted with a good tap. All the grinding had to be done very perfectly, so as to keep a vacuum for some hours even at a slightly raised temperature. About the centre of each tube the electrodes, contained in tubulures slanted up so as to prevent the entrance of the explosive material, are attached. The parts of the tubes below these tubulures are filled with the substance to be examined, the stoppers replaced, and the tube exhausted by means of a good pump (not a mercury pump). The parts of the tube containing the explosive are then immersed in hot water (about 90° C.), and a discharge from a powerful induction coil (we use a 6-in. coil) passed through it. The capillary tube is then examined, end on, the use of a condenser greatly intensifying the brilliance of the spectrum. If mercury, or a volatile mercury salt, is present, even in very minute quantities, the characteristic lines of the mercury spectrum are seen in addition to those of any other gases that may be present, *e.g.*, nitrogen, oxygen, hydrogen, etc. The spectrum of the nitrogen may be eliminated by passing a stream of hydrogen through the cold tube before exhaustion, when, after exhaustion, practically only the spectra of mercury (should this be present), hydrogen, and oxygen, will be seen. The hydrogen and oxygen spectra can never be eliminated, as it is impossible to get rid of the last traces of moisture ; but this does not in any way interfere with the mercury spectrum.

The lines we rely on for proving the presence of mercury are the two yellow, the green, and the violet of the following wave lengths :—The yellow, 5,790 and 5,769 ; the green, 5,461 ; and the violet, 4,359. At present we never certify the presence of mercury unless all these lines are seen. All the apparatus used, tube, connections, etc., etc., must be carefully tested to prove the absence of mercury before each test is carried out.

Tests at Present in use for Ungelatinized Guncotton. About 2 grams of the nitro-cotton are carefully dried, at a temperature not exceeding 120° F., introduced into the special vacuum tube, and the test carried out as described above.

For Blasting Gelatine, Gelignite, etc. About 4 grams of the explosive are ground up with French chalk, introduced into the vacuum tube, and tested as above. If the explosive contains a considerable amount of moisture, the introduction of a piece of calcium chloride above the explosive in each limb may be of considerable advantage. Blank experiments must be made with the chalk used before the test is carried out.

For Cordite. Fifteen grams of the cordite are ground so as to pass through the finest sieve of the heat tests set, and extracted with ether for two hours. The flask is then removed, and a carefully cleaned flask substituted ; fresh ether is introduced, and the extraction continued for a further 10 hours. The ether is then distilled off, and the flask carefully dried at a low temperature. The flask is washed out with several quantities of boiling distilled water, a little hydrochloric acid being added to the first boiling. The washings are put into a previously ignited platinum dish, and the solution electrolysed over night, using the dish as anode and a coil of platinum or gold wire as kathode (we use two Leclanché cells in series for the electrolysis). The wire is then washed with water and acetone, dried at a low temperature, dropped into a clean narrow test tube (3ins. by $\frac{3}{8}$ in.), and the part of the tube containing the wire strongly ignited. The bottom of the tube is cut off, after removing the wire, the remainder dropped into the vacuum tube and tested for mercury as already described.

Hard Gelatinized Nitro-cotton Preparations. These are treated exactly as cordite, unless the explosive contains nothing which is soluble in ether, other than a mercury salt, when the initial two hours' extraction with ether is omitted.

Specially Delicate Tests. If an ungelatinized nitro-cotton has to be tested for very minute traces of soluble mercury salts, any desired quantity can be extracted with ether and treated as above for hard gelatinized nitro-cotton explosives.

All the above tests in which extraction by ether is employed are, of course, only tests for soluble mercury salts, not for metallic mercury. The following tests, which we employ as a very delicate test for use with blasting gelatine and similar explosives, may also be used for any class of explosive when only metallic mercury is to be tested for, and by using appropriate quantities a test of any desired delicacy can be obtained.

Delicate Test for Blasting Gelatine, etc. Fifteen grams (or any other desired quantity) are ground up with French chalk and introduced into a stoppered glass bottle. A piece of previously ignited silver foil, contained in a glass spoon, is placed on top of the explosive, the bottle tightly stoppered and kept at a temperature of from 90 to 100° C. for from 10 to 15 hours. The silver foil is then treated in the same way as the coil in the cordite test.

Considerable difficulty has been experienced by firms who have been using mercury in their explosives in the past in getting their plant free from all traces of the salt used. Even six months after the last addition of mercury the explosive contains enough very seriously to affect the heat test. In this connection it may be of service to point out the extremely minute amount of mercury that may influence the result. From quantitative experiments we have made, we have found that even so small a quantity of mercury as 1,000th milligram can combine with as much iodine as would be liberated by an average sample of blasting gelatine in the five minutes after the standard tint on the test paper had been reached, or, in other words, is capable of masking the heat test by five minutes. Extreme care is therefore necessary in cleaning the plant after mercury has once been used, and the alternate use of the same plant for explosives containing mercury, and for those intended to be free, is probably out of the question.

With reference to the rejection of explosives on account of their containing mercury, it was suggested that the main objection to its use, viz., its affect on the heat test, might be overcome by introducing a piece of siver foil into the tube during the test. It was alleged that the mercury was thus completely retained by the silver, and that the true test of the explosive was obtained. This point was therefore investigated, but it was found that, although the effect of the mercury on the test paper was undoubtedly counteracted, and a test which had been much prolonged by the presence of mercury was considerably shortened, yet the silver itself had a considerable masking effect, probably due to the absorption of the acid vapours by the silver. It was, therefore, concluded that, although the above test might be useful as a supplementary test for the presence of mercury, it could not be considered to remove the objections to the use of mercury in explosives. The use of gold foil was also suggested, but although preferable to silver for use with nitro-cotton in that its masking effect is decidedly less, yet, since it has a strong decomposing effect on nitro-glycerine vapour its use with nitro-glycerine explosives is quite inadmissable.

The general work of the department shows no unusual features apart from the one already so fully dealt with. Under the headings: manufacture, storage, packing and conveyance and so forth the remarks summarising the year's work show that the routine work has been carried on in the usual manner. Capt. Desborough's work at the Woolwich testing station as usual forms the subject of a special report. Among the enquiries which have received particular attention is one concerning the relative effect of samples of coal dust distributed along the gallery. It was found impossible to establish any definite relationship between inflammability and chemical constitution of the dust as determined by analysis. In a similar fashion newly ground dust seemed to be more sensitive than material which had been in that form for some time, but it was found difficult to establish any conclusive deductions. On the other hand distinct progress has been made towards demarking the degrees of sensitiveness of various types of dust, the borderline consisting of dusts incapable of propagating ignition, but in some cases producing a noticeable increase in the volume of visible flame given off by the explosion of a charge of gunpowder. Other subjects investigated were the effect of a tamping of soda on the liability to ignition, and the use of a small experimental tube to enable colliery managers to test the sensitiveness of samples of dust lying about the roadways and other places of accumulation in mines.

The amounts of foreign blasting powders containing nitroglycerine imported in 1908 was 1,341,900 lbs. as against 3,558,662 in the previous year. It is pointed out that all explosives brought into British ports for transhipment are regarded as imported, and that more than half for instance of the total for 1907 was known to have been reshipped to other countries. The reason of the falling off in the past year of the quantity of explosive imported is that several consignments were rejected and returned to the port of origin, the cause of rejection being either that they contained an unauthorized ingredient or that they failed to pass the heat test. As a consequence of these defects, certain facilities for transhipment which had been given to some foreign firms had to be temporarily withdrawn, with the result that such transhipments became less frequent. A very serious explosion which occurred at one continental factory, crippling their output, is also a cause of diminution of the importations. The number of detonators imported during the year was 18,387,800 as against 23,932,225 in 1906. Of the above total 4,110,000 are known to have been immediately transhipped to other countries. The following detailed analysis of importations is taken from an appendix to the report :—

Blasting Gelatine.
- Alliance Explosives Co., Ld. .. .. .. 240,500lbs.
- Cotton Powder Co., Ld. .. .. .. 5,050lbs.
- W. Marden & Co. .. .. 85,000lbs.
- J. R. Watson & Co. .. .. 6,000lbs.

Carbonite.—Carbonite Syn. Ld. .. .. .. 156,000lbs.
Celtite.—A. J. Brown & Co. .. .. 10,000lbs.
Cooppal Powder.—J. R. Watson & Co. .. .. 3,650lbs.
Detonators—
- Alliance Explosives Co., Ld. 385,000
- W. N. Blakeley 60,000
- W. T. Bridges & Co. 28,000
- A. J. Brown & Co. 1,128,000
- Cotton Powder Co., Ld. 4,500
- Fleming & Co. 411,000
- W. Marden & Co. 945,000
- C. G. Mueller 5,347,000
- S. Salisbury 1,889,300
- J. R. Watson & Co. 8,190,000

Detonators for Fuses–Coventry Ordnance Wks. Ld. 230,000
Dynamite—
- Alliance Explosives Co., Ld. .. .. .. 99,500lbs.
- Nobels Explosives Co., Ld. .. .. .. 2,600lbs.
- J. R. Watson & Co. .. .. 30,500lbs.

Emerald Powder—J. R. Watson & Co. .. .. 650lbs.
Fuse Heads—Nobel's Explosives Co., Ld. .. .. 11,532,000lbs.
Gelatine Dynamite, or Gelignite—
- Alliance Explosives Co., Ld. .. .. .. 333,000lbs.
- W. N. Blakeley .. .. 15,000lbs.
- A. J. Brown & Co. .. .. 140,000lbs.
- Cotton Powder Co., Ld. .. .. .. 7,250lbs.
- W. Marden & Co. .. .. 176,000lbs.
- J. R. Watson & Co. .. .. 20,500lbs.

German Government Military Rifle Powder—
- Kynoch Ld. .. .. 52,051lbs.

Manufactured Fireworks .. .. 445,330lbs.
Normal Powder No. 2—Normal Powder Co., Ld. .. 10,000lbs.
Permonite—Carbonite Syn., Ld. .. .. .. 107,000lbs.

The following quantities of permitted explosives used during the year, is quoted from the report together with the percentage relation to the total :—

Name of Explosive.	Manufacturer.	Quantity used. lbs.	Per Cent. of Total.
Saxonite	Nobel's	1,721,193	19·5
Ammonal	Roth, Felixdorf	1,134,806	12.8
Bobbinite	Curtis's & Harvey	1,063,111	12·0
Monobel Powder	Nobel's	711,691	8·0
Ammonite	Miners' Safety Explosives	562,405	6·2
Carbonite	Carbonite Syndicate	551,948	6·2
Roburite	Roburite Explosives Co.	510,438	5·8
Arkite	Kynoch	437,780	5·0
Westfalite	British Westfalite	405,691	4·8
Bellite	Lancashire Explosives	371,455	4·2
Rippite	Curtis's & Harvey	306,408	3·5
Faversham Powder	Cotton Powder Co.	224,200	2·5
Stow-ite	New Explosives Co.	180,393	2·0
Amvis	Roburite Explosives Co.	87,863	1·0
Excellite	Curtis's & Harvey	80,951	0·9
Abbcite	Kynoch	75,914	0·9
Withnell Powder	Lancashire Explosives	66,620	0·7
Negro Powder	Roburite	60,933	0·7
Electronite	Curtis's & Harvey	41,649	0·5
Geloxite	Cotton Powder Co.	39,644	0·4
Kolax	Curtis's & Harvey	35,340	0·4
Permonite	Carbonite Syndicate	26,738	0·3
Cornish Powder	National Explosives Co.	24,912	0·3
Dragonite	Curtis's & Harvey	22,534	0·3
Oaklite	Exps. & Chem. Prod. Ld.	18,584	0·2
Curtisite	Curtis's & Harvey	12,424	0·1
Ripping Ammonal	Ammonal Exps.	10,333	0·1
Rexite	Cotton Powder Co.	9,935	0·1
Cambrite	Nobel's	9,121	0·1
Aphosite	Nitrate Exps. Co.	8,700	0·1
Kynite	Kynoch	7,533	0·1
Eleven other Explosives		22,871	0·3
Total		8,844,118	100·0

PROOF HOUSE PROSECUTION.

At the Birmingham Police Court on the 6th ult., the Guardians of the Birmingham Proof House proceeded against Henry Ludlow England, trading as the Midland Gun Company, Price Street, for unlawfully selling to one C. A. Miller, Lansdown, Stroud, three single-barrelled rifles and engraving on the barrels the name of C. A. Miller, Stroud, the barrels not being proved under the Act of 1868.

Mr. Joseph Rowlands, who represented the Guardians, said that the law provided that the barrels of all small-arms sold in this country must be proved by one of the proof houses in London or Birmingham, and that such barrels had to be marked showing what proofs they had undergone. Under another section of the Act, however, Parliament had been very kind to foreign gun manufacturers. They had allowed any official proof marks which might be put upon foreign made parts to be registered in this country. The barrels in question bore the Belgian proof mark, and if there were not other marks or names upon the barrels no complaint would have been made against the defendant, but under another section exemption from proof in this country was not to apply if the barrels had any name, mark, sign, or character upon them from which it might be taken that they were of English make or manufacture, the reason of this being obviously that foreign-made arms should not be sold in this country as of English make. In this case the defendant received an order from a Mr. Miller, of Stroud, who dealt in guns, for three Martini rifles upon which the defendant was instructed to put the name C. A. Miller, Stroud. He accepted that order, carried out the instruction, and delivered the rifles, the price being £1 2s. 6d. each. An English-made arm of the same class would cost about double the amount. It was true that they bore the Belgian proof mark, but the ordinary purchaser would not be acquainted with the difference between the English and foreign proof marks, and would see the name of Miller, Stroud. The defendant was a highly-respectable gunmaker in Birmingham, and also occupied an official position in connection with the Proof House, being a member of the Board of Registry. Whenever conduct such as this was brought to the attention of the Guardians they invariably prosecuted.

Mr. T. Turner, proof master, gave evidence, and was asked by the defendant if the guns could be quite legally sold in this country without the name C. A. Miller, and replied in the affirmative.

Defendant: And it would be quite open to us to take the Belgian proof mark off and have them proved by an English Proof House?

Witness: It would be perfectly legal.

The defendant, in addressing the Acting Stipendiary, said the order was received for these three guns during his absence from the works on business. They were certainly named with the name C. A. Miller, Stroud, according to the instruction. Had he known anything of the transaction he should not have allowed it to have been done. It was, however, impossible for anyone to be deceived by the marking on these rifles, because the foreign proof mark was well-known in this country. The man to whom the rifles were sold would see the foreign proof marks, which were given in the price lists. Mr. England went on to allege that when a similar case occurred in the works of a Guardian no prosecution was taken.

Mr. Rowlands: A statement like that should not be made unless on oath.

Defendant: Then I am prepared to go into the witness box.

Mr. Grimley imposed a penalty of £15, and made an order for five guineas costs.

Mr. W. L. Powell, on behalf of the Guardians of the Proof House, said he was very much surprised at the statement made by the defendant that Guardians of the Proof House had been guilty of the same offence, and had not been prosecuted. Such a statement was extremely untrue, and on behalf of his colleagues he very much resented it having been made.

Mr. Grimley: I attach the same weight to his statement as I do to his defence.

APPLICATIONS FOR PATENTS.

JULY 20—AUGUST 22, 1908.

15,330.* Electrical Fusible Cartridges. P. Weisse.
15,496.* Targets. H. Kamman and A. Kaszab.
15,500. Target Practice Apparatus. F. Mitchell.
15,514. Sights for Small Arms. D. Marshall.
15,557.* Firearm Recoil Absorbers. G. Easdale.
15,619.* Cartridge Turnover Machines. C. Osborne & Co., Ld. and A. E. B. Wilkinson.
15,643. Cut-off Gear for Ordnance. Sir W. G. Armstrong, Whitworth & Co., Ld., and C. H. Murray.
15,769.* Automatic Firearms. A. G. Bloxam.
15,882. Single-trigger Mechanism. J. W. Smallman.
15,916. Explosives. B. E. D. Kilburn.
15,917. Projectiles. S. O. Cowper-Coles.
15,918. Ordnance Loading Apparatus. Vickers Sons & Maxim, Ld., and L. Silverman.
15,928. Automatic Small Arms. J. Eastwick.
16,079.* Timing Fuses. W. Fritsch.
16,205.* Ordnance Aiming Device. Rheinische Metallwaaren und Maschinenfabrik.
16,280.* Firearms. J. C. White.
16,343.* Automatic Firearms. A. G. Bloxam.
16,370.* Automatic Machine Guns. A. T. Dawson.
16,375. Target. J. A. Stubbs.
16,463. Range Finders. J. T. Dreyer and F. C. Dreyer.
16,495.* Barrel Recoil Gun Carriages. Fried Krupp, A.-G.
16,503. Ordnance Firing Gear. A. T. Dawson and G. T. Buckham.
16,511. Ordnance Firing Gear. A. T. Dawson and G. T. Buckham.
16,515. Ordnance Breech Mechanism. A. T. Dawson and G. T. Buckham.
16,587.* Fluid Pressure Brakes for Ordnance. Fried Krupp.
16,588.* Fire Projectiles. Fried Krupp.
16,599.* Explosives. J. Rudeloff.
16,673. Target Practice Apparatus. J. B. Bolitho.
16,715.* Automatic Firearms. N. Pieper.
16,814.* Field Gun Carriages. La Société Schneider & Cie.
16,824.* Rifles. H. Sunngard.
16,864. Charging Spring Guns. D. Marshall.
16,870.* Projectile. S. Hoffmann.
16,912. Controlling Gun Fire. J. T. Dreyer and F. C. Dreyer.
16,980.* Field Gun Carriages. J. A. Deport.
17,066.* Breech Loading Firearms. L. Martinez-Silva.
17,257. Targets. M. M. Paterson.
17,330.* Moving Targets. P. Chiantore.
17,359.* Ammunition Hoists. Sir W. G. Armstrong Whitworth & Co., Ld., and C. H. Murray.
17,371. Testing Ordnance Sighting Apparatus. W. A. Burns.
17,453. Armour Piercing Projectiles. T. J. Tresidder, J. R. Hoyle, and H. B. Strange.
17,623.* Cartridge Pockets. W. C. Fisher.
17,629.* Automatic Firearms. N. Pieper.
17,696.* Ordnance Projectiles. L. D. de Lanneau.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

JULY 30—AUGUST 27, 1908.

COMPILED BY HENRY TARRANT.

17,877 (1907). **Treatment of Decomposing Explosives.** A. C. Luck, Argentine Republic. (*See Selected Patents*).

19,519 (1907). **Sights for Air Guns.** The leaf of this air gun sight has a spring beneath it by which it is raised when the thumbscrew holding it is turned upwards. The sight is

depressed against the action of the spring by turning the thumbscrew down. Accepted July 16, 1908.

21,237 (1907). **Ordnance Sighting.** W. Beardmore & Co., Ld., and A. Bremberg, Glasgow. Elevating and sighting gear for ordnance which allows laying and sight setting to be performed independently and simultaneously, the line of sight being practically unaffected by the operation of the sight setting mechanism. Drift correction may also be made irrespective of the lateral level of the carriage wheels. Patent No. 20,194, 1903, is mentioned in connection with the sight setting clutch mechanism. Accepted July 23, 1908.

21,598 (1907). **Ordnance Ammunition Hoist.** A. F. Petch and F. Duncan, London. An upper ammunition hoist for heavy ordnance in which the cage in its highest position with respect to the gun is clear of the gun during recoil, but may be swung out into position for ramming the ammunition directly from it into the gun, without further raising. Accepted July 23, 1908.

23,656 (1907). **Ammunition Supply to Pair Gun Mountings.** A. F. Petch, and F. Duncan, London. The powder and projectiles are raised in the trunk by separate hoists but they are both discharged at the top of the trunk into trays lying one immediately above the other. From these trays they are rammed into the upper hoist cage preparatory to loading. Accepted July 23, 1908.

23,8[illegible]9 (1907). **Non-Fulminate Percussion Caps.** The King's Norton Metal Co., Ld., London, H. M. Smith, Abbey Wood and H. W. Brownsdon, London. (*See Selected Patents*).

25,137 (1907). **Metallic Fouling Removal from Ordnance Barrels.** King's Norton Metal Co., Ld., and T. R. Bayliss, London, and A. E. Payne, Birmingham. The method of removing metallic fouling from the bores of ordnance as described in Patent No. 717, 1906, is improved upon by the present patentees. The cathode of the electrolytic arrangement is given a rotary motion so as to allow of the employment of electrical currents of greater density and to accelerate the process of fouling removal. Accepted July 23, 1908.

25,175 (1907). **Bolt Action Rifle Loading.** The Birmingham Small-Arms Co., Ld., A. H. M. Driver and G. Norman, Birmingham. (*See Selected Patents*).

25,939 (1907). **Air Rifle Cocking Lever Arrangement.** G. F. Urry, Birmingham. (*See Selected Patents*).

27,065 (1907). **Sporting Gun Action Bodies.** H. E. England (Holloway & Co.), Birmingham. Instead of constructing the extractor lifter of break down sporting guns on the fore end iron as usual the patentee leaves sufficient metal on the action body forging to allow the lifter to form part of the finished action. Anson-Deeley actions are particularly referred to. Reference is directed under Sec. 7, Sub-Sec. 4 of the Patents Act 1907, to Patents Nos. 19,395 1890 and 6,094, 1892. Accepted July 23, 1908.

28,553 (1907). **Diminishing Sound of Discharge of Projectiles.** S. Rogozea, Paris. The projectile is frictionally secured to the front of a conical part. Projectile and conical part are propelled down the barrel together and at the muzzle they part leaving the conical part firmly wedged so as to prevent the efflux of gases of combustion which escape rearwardly through channels in the breech. Noise of discharge is stated to be deadened and recoil eliminated. Accepted July 9, 1908.

2,489 (1908). **Sub-Target Aiming Apparatus.** H. B. Hollifield, U.S.A. A rod is inserted in the barrel of the rifle. Where the rod projects from the muzzle it is bent down so that its sharp end lies parallel with the bore but a little below it. When the trigger is pulled the rod is propelled forward, the sharp rod end perforates the sub-target, and a spring returns the rod to its original position. Accepted July 23, 1908.

3,134 (1908). **Ordnance Breech and Firing Mechanism.** H. T. Wheeler, U.S.A. Firing mechanism, in which the electrical or percussion hammer is carried in a sliding piece, is improved. Greater security and positive action are claimed. The mechanism cannot be operated except when the breech block is in the closed and locked position. Accepted July 23, 1908.

3,144 (1908). **Firing Mechanism of Ordnance.** The mechanism dealt with in this patent is similar to that forming the subject of specification No. 3,134, 1908 above, but a spring operated retainer for primer cases is introduced. Accepted July 23, 1908.

4,046 (1908). **Explosive Composition.** F. W. Bawden, Transvaal. An improved explosive of the class composed of oxidised chlorates or nitrates and hydrocarbons or carbohydrates is dealt with in this patent. Golden syrup or uncrystallisable sugar residue is used principally in conjunction with potassium chlorate. Different proportions are mentioned for different classes of work. The syrup forms approximately 25%–50% of the explosive. Accepted July 16, 1908.

4,713 (1908). Single Trigger Mechanism for Double Barrelled Guns. R. F. MacMichael, U.S.A. A vertical pillar carries the firing collar through which the sears are lifted one after the other. The pillar is lifted bodily when the trigger is pulled and is returned to normal position by a spring which also rotates the firing collar. The trigger is mounted so that when the gun recoils inertia causes it to slide forward so as to disengage it from the firing collar and prevent the involuntary pull doing harm.

7,570 (1908). **Sight Adjustment for Ordnance.** Fried Krupp, A.-G., Germany. The present sighting appliances for firearms are only correct for those targets that lie in the muzzle horizon, that is to say within the horizontal plane passing through the centre of the muzzle. In order to hit targets at which the angle is very great, such as an airship, considerable adjustment of the sights has to be made and an appliance is introduced by the patentees whereby such adjustments may easily be read off. Accepted July 9, 1908.

8,772 (1908). **Ordnance Cartridges.** Fried. Krupp, A.-G., Germany. The production of an easily detachable bayonet joint like connection between projectile and cartridge case consists in providing one with projections and the other with an angular groove. It is claimed that destruction of the means of connection during transport cannot take place. Accepted July 9, 1908.

9,143 (1908). **Automatic Pistol Mechanism.** J. A. Fidjeland, Norway. Automatic pistol mechanism in which the breech block does not turn during operation, is provided with safety mechanism which locks the hammer when either cocked or uncocked and exposes a limb to show that the parts are at "safe." Accepted July 23, 1908.

SELECTED PATENTS.

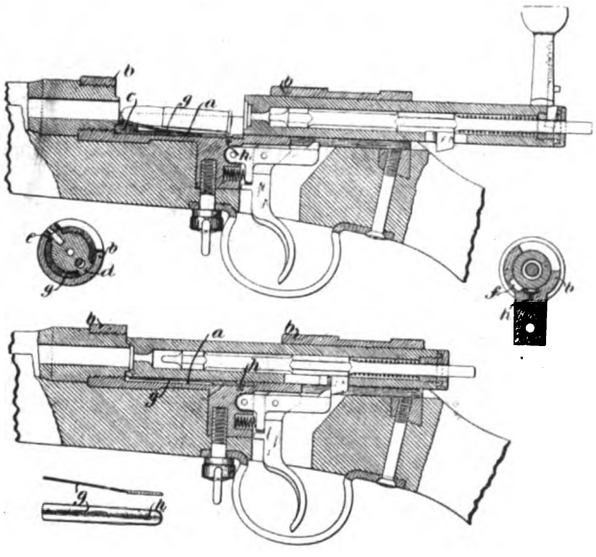
TREATMENT OF DECOMPOSING EXPLOSIVES.

17,877 (1907). A. C. Luck, Argentine Republic. Nitrocellulose, nitroglycerine and similar explosives are liable to decompose and to form other bodies which accelerate further decomposition. The "Abel Heat test" is used to indicate the presence of products of such decomposition, one condition being that if the time which elapses between the beginning and end of the test be less than six minutes at 160°F. the explosive has to be destroyed. The patentee has discovered a method of treating compounds which will not stand the test, by means of which their stability is restored and the necessity for destruction of the mass is nullified. The explosive is placed in a suitable receptacle and by means of an exhauster the decomposing bodies are extracted or dispelled, the time required for the treatment being reduced if some heat be applied whilst the explosive is under treatment.

Cordite of nine-twentieths of an inch diameter, giving a very low heat test—one of about four minutes only—if treated by this process for about eight days at normal temperature, will it is claimed, give a heat test of over fifteen minutes, whilst if a temperature of 100°F. is maintained for about thirty-six hours the cordite will give a heat test of over twenty-five minutes. Alkaline substances are quoted as suitable for absorbing or destroying any acid or other injurious bodies which may be set free by the explosives. These alkaline substances may be placed anywhere in the vessels containing the explosives, and a convenient way to use one, say sodium carbonate in solution, is to treat paper or cellulose with it, dry it and place it in the compartment which contains the explosive. Accepted July 16, 1908.

FACILITATING LOADING OF BOLT RIFLES.

25,175 (1907). The Birmingham Small Arms Co., Ld., A. H. M. Driver, and G. Norman, Birmingham. To facilitate the loading of bolt action rifles wherein the bolt race-way in the body lies in a lower plane than the chambered end of the barrel, the patentees introduce a spring platform which allows the cartridges after being dropped through the aperture in the body to be shoved straight into the chamber by the forward movement of the bolt during the closing operation. They claim that this is an improvement on a known arrangement because the latter consists of a complicated spring arrangement which has to be compressed by the cartridge, whereas the present device is quite simple and is compressed by the bolt. The device is applied in this instance to rifles known as the forward lug resistance type.



The cartridge guide is illustrated in the drawings appearing herewith. The bolt race-way *a* of the action body *b* is machined at *c* to accomodate the bolt locking lugs *d* and *e* on the bolt head. The lug *d* is adapted to move during opening and closing of the bolt in the slot *f* cut in side of the action body. It will be observed that the bottom of the body *b* lies in an appreciably lower plane than the cartridge chamber, and to enable the cartridges to be fed out of the race-way merely by the act of closing the bolt the spring platform, tongue, or yeilding cartridge lead *g* is introduced. When the bolt is withdrawn this tongue *g* extends at a gradual inclination from the bottom of the race-way to the cartridge chamber, so that when a cartridge is dropped into the race-way the bullet lies on the inclined lead and is pushed properly into the chamber when the bolt is pressed forward to close the rifle. As the bolt moves home its head depresses the spring lead *g* so as to allow the locking lugs *d* and *e* to be turned into the locking groove *c*. The spring is secured to the body by the screw *h*. Accepted July 16, 1908.

A NON-FULMINATE PERCUSSION CAP.

23,819 (1907). The King's Norton Metal Co., Ld., London, H. Melville Smith, Abbey Wood, and H. W. Brownsdon, London. The patentees propose to dispense with fulminate of mercury, stated to be comparatively unsafe and costly, and to introduce non-fulminate caps possessing such a high standard of efficiency that they compare quite favourably with the ordinary fulminate cap now generally used.

Non-fulminates, say the patentees, require very close confinement to secure regular results, and therefore, they superimpose on the surface of their non-fulminate composition mentioned below, a perforated metal disc, or a cardboard disc which need not be perforated. These discs are attached firmly to the surface of the composition in the cap by means of shellac or other adhesives. In the case of a cardboard disc a shellac is used which contains in suspension a metallic powder such as aluminium.

The non-fulminate composition for military cartridges is composed of 24 parts by weight of antimony sulphide, 10 parts by weight of sulphur, 50 parts by weight of potassium chlorate and 16 parts by weight of manganese dioxide. A charge weighing 0·6 gr. is pressed into the cap and the cardboard disc of one-hundredth of an inch thickness covers it. In smaller caps sufficient confinement is secured merely by covering the non-fulminate charge with several applications of a solution of celluloid in acetone mixed with aluminium powder.

Powdered pyrolusite (known as black manganese) added to the non-fulminate composition helps to secure a regular explosion. The pyrolusite is of a gritty nature, it does not impair the sensitiveness of the compound and renders unnecessary the use of ground glass.

No broad claim is made to the use of manganese dioxide, and the patentees are aware that it has been proposed to use shallow perforated cups or flanged metallic discs to confine the charge in the cap. Accepted July 9, 1908.

SPRING COMPRESSING LEVERS FOR AIR RIFLES.

25,939 (1907). G. F. Urry, Birmingham. Air rifles of the fixed barrel type which were dealt with in patent No. 8,761 of 1904 have a lever lying normally beneath the barrel. This lever is moved on a pivot towards the stock of the rifle to compress the plunger spring through the medium of a rigid link. The present patentee now proposes to connect the lever with the link by a sliding pivot, and he claims that the new arrangement allows the spring to be compressed with less manual exertion, more especially towards the end of the compressing operation when most power in the ordinary way is needed.

The drawings here reproduced show that the ordinary form of "cocking" lever *a* is used and that its fulcrum is at *b* beneath the loading plug as usual. Just in front of the loading plug *c* is arranged the lug *d* which carries the pivot pin *e* on which works one end of the short link *f*. The other end of the short link is pivotted at *g* to the end of a second short link *h* whose other end is pivotted at *i* to the forward end of the plunger link *j*. The pivot *i* as is shown engages in the slot *n* cut longitudinally in the cocking lever *a*, and is adapted to traverse the slot *n* substantially from end to end during the cocking movements.

Fig 1

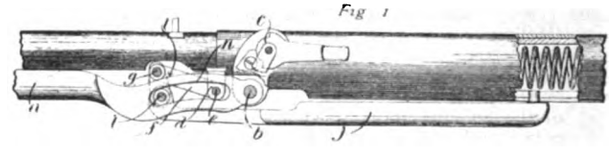
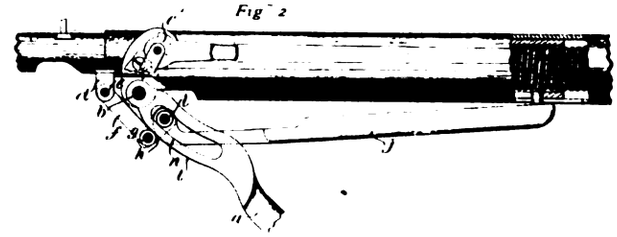


Fig 2



When the cocking lever *a* is moved from its normal position (Fig. 1) the pivot *i* gradually travels from the forward end of the slot towards the fulcrum *b* of the lever *a* until as is shown in Fig. 2, it lies in the rear extremity of the slot. It is stated that as the cocking lever moves round towards the position shown in Fig. 2 the pivot *i* continually assumes positions relative to the fulcrum *b* such as will make the operation of spring compressing more easy than heretofore in respect to the power required. The pivot *i* may be a roller and the pivot *g* may also be adapted to roll over the edge *l* of the cocking lever *a*.

The first claim in the patentees specification reads as follows:—"In the cocking mechanism for air guns of the kind referred to, connecting the plunger link to the cocking lever by a movable or shifting connection, or pivot or equivalent in a manner increasing the leverage in the cocking operation." Accepted July 16, 1908.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 193.—Vol. XVI. OCTOBER, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

High Velocity of Sporting Powders.—This month's leading article deals with a subject which introduces incidentally the question of the difficulty which powder makers are experiencing to keep the velocity of their products within reasonable bounds. Pressure can be maintained at the required level as long as high velocity is tolerated. That it is a disadvantage is beginning to be recognised, notwithstanding that many of the books which deal with shooting subjects oppose this view with peevish insistence. It is difficult to explain to the person casually interested in shooting how this can be so, but the solid fact remains that the higher the velocity the more frequent are the complaints of general weakness and deficient penetration. The well tried 1⅛oz. charge never gave any trouble in this respect; but with the introduction of the so-called low-recoil loads, high velocity became a literal bug-bear, the more so because its pernicious nature was never suspected. The manufacture of nitrocellulose has been so improved of late years that powders will insist on giving off such quantities of gas as to impart higher velocity than is desirable. Taming agents provide but a slender reed to lean upon, for their tendency is rather to reduce pressure than velocity, the opposite in fact to what is required. The modern powder is at times in need of some inert form of dirt which will increase bulk and weight without adding to the explosive effect. It must not, like barium, fuse into granules known as blow back, but it must resolve itself into impalpable and unobjectionable dust. Another remedy would be to reduce the weight of the standard charge, but here again manufacturing changes are involved, and it is a question whether the evil is as deep-rooted as to need radical remedies of this nature. The more hopeful view is to assume that a view so revolutionary in its tendency has not had time to become properly absorbed. So soon, therefore, as powder making experts realise that there are positive disadvantages in velocity above a certain level they will not be slow to find the necessary remedy.

The Shooting Season.—The general verdict about the shooting season so far as it has progressed up to date is that the results are decidedly patchy, one owner's experience being the direct opposite to another's, a state of affairs which fits in with a year in which a good breeding season was followed by peculiarities of weather, whose effects are differently felt according to the nature of the surface soil. Shoots situated on sandy ground appear to have best survived the two periods of drought which marked the summer season, always provided of course that a constant water supply was available to prevent the young broods suffering from thirst. Everyone hoped that there would be a phenomenally good season, and the favourable forecasts have been fulfilled in so many directions as to justify the interpretation that was based on the favourable weather during the critical weeks of June. The estates which have suffered from the subsequent vagaries of weather will have an uncertain effect on the season's total result. With so many records of a highly favourable nature it is very easy to wipe out the deficiency in other directions, and produce what will in due course be summed up as an average season. Ground game have enjoyed an ample opportunity of making up the losses due to the boisterous spring weather, and their con-

tribution to the total consumption of cartridges must not be ignored in days when nearly every farmer takes full advantage of the Ground Game Act. Financial conditions are undoubtedly better than for a long time past, and the extraordinarily successful London season, followed by a phenomenal incursion of foreign visitors, must have resulted in the distribution of large quantities of money, a share of which will naturally be available for the pursuit of sport during the slack winter months to come. From the gunmaker's point of view the capacity to spend money on shooting is quite as important as a plentiful supply of birds, and there are many reasons for supposing that the two elements combined will be found to have produced satisfactory results when the time arrives for casting the total.

The Trade in Pistols.—Some recent experiences of an energetic attempt to purchase a particular type of pistol led to the discovery that what may be termed the counter trade in these articles has diminished to the slenderest proportions. The time was when many firms did a considerable cash business in these small firearms. The motive on the purchaser's side was in the large generality of instances a mere fancy to possess one of the bright and glittering toys which make such an attractive display in the gunsmith's window. A box of cartridges was inevitably purchased with the pistol, and a small number of rounds was fired in some more or less suitable, but generally entirely safe, situation. Following this baptism of fire the pistol would be carefully greased and put away, imparting to the user a pleasant and unaccustomed sense of security, whose novelty is hardly justified in a country having policemen at most of the street corners. The harmless fancy to become the possessor of a pistol has been so much checked by the operations of the Pistols Act that gunmakers have much diminished their stock of the lighter and more portable varieties. A welcome exception is made in favour of weapons with 10-inch barrels. These are outside the Act, and though their length diminishes portability it favours accuracy for target practice. Experience in the working of the Act has unfortunately shown no easing of the difficulties incidental to supplying pistols to persons proceeding abroad, though as regards householders the signature on the necessary declaration provides a simple procedure which appears to have worked well in practice. The only trouble still remaining is the constant anxiety lest persons in a suicidal frame of mind should unwittingly be supplied. The unpleasantness of attending inquest proceedings, and of having to meet the veiled insinuations that the desire for profit blunted the powers of observation, must leave an abiding sense of suspicion against all would-be purchasers of what is in most instances a harmless, or else necessary, item of equipment.

Next Year's Bisley Sights.—The present time of year is one when the decision of the National Rifle Association, concerning the rules for next season's rifle shooting, is anxiously awaited. The term match rifle is indiscriminately used in many quarters to indicate a rifle complying with the military pattern and bearing the usual view marks, but fitted with the special appliances and sights allowed by the Bisley regulations. Strictly speaking the term match should be restricted to rifles so named and defined by N.R.A. regulations. The term would then be restricted to weapons of military calibre and fitted with match sights, the essential feature of which is that they enable the rifle to be used in the back position. A distinctive term is certainly required to differentiate the ordinary volunteer rifle from the specially selected weapons which the better known crack shots are in the habit of using. Several of the best known purveyors of these weapons grew into the business from the small commencement of applying the marksman's keen perception of quality to the selection of weapons for friends. The service so performed involved the expenditure of time in trying the rifle, and a certain amount of expense out of pocket, obviously to be covered by securing the trade discount. These weapons earned a high reputation, partly on account of the careful test which they received upon delivery, but especially because the manufacturer very wisely took special pains in their production. The term match was applied to them, because of the aptness of the description, and it will no doubt continue in use so long as present conditions prevail. The N.R.A. have increased the distinction between these weapons and those of strictly service pattern by the recognition of special sights differing radically from those issued for service with the rifle. Everything now turns upon an early announcement of the governing conditions, which it may be hoped will place restrictions on the use of mere amateur's models.

The Position of Match Rifle Shooting.—The extraordinary renewal of interest in match rifle shooting which characterised this year's proceedings at Bisley will not be lessened by the technical interest associated with the battle between the old well-tried cartridges firing bullets of ·303 calibre and the more modern type, of which the Ross-Eley is the accepted parent. The essential features of this cartridge are very difficult to appreciate from the strictly target shooting point of view. The ground-work of its claim to special excellence is the attainment of a very high velocity throughout the whole length of the range. That is to say the cartridge must not be judged by the muzzle velocity alone, for that could easily be beaten, but rather by the high average velocity taking all points along the range into account. The origin of this high standard of result is the large capacity of the cartridge case in relation to the calibre of the bore, conditions which can of course be repeated by necking down one of the existing cartridges to the reduced ·280 calibre. The rifle has received a practical trial at the hands of such a limited number of shooters that it is impossible to differentiate from the results achieved the personal element, viz., the precise amount of skill employed and the advantage which was more properly due to the combination of qualities in the rifle and cartridge. From a rifle shooting point of view the question is complicated by the necessity to know beforehand what are likely to be next year's conditions. Several very important considerations turn upon certain items of specification which may be regarded as subject to change until it has been definitely announced that they are to remain in vogue during the coming season.

THE LOADING OF LIGHT 12-BORE CHARGES.

One of the most telling arguments in favour of the 16-bore gun is the recent considerable increase of demand for cartridges carrying a $\frac{15}{16}$ oz. charge of shot. Existing guns must be served with the ammunition favoured by their users, and the very greatness of the difficulty in meeting their wishes provides the necessary argument in favour of a reduction of calibre. Some gunmakers assert that the 16-bore is making no headway; but others wiser in their generation find it easier to sell 16's than 12's and they make new trade by doing so. The old argument as to whether, if a change must be made, it would not be better to plump for the 20-bore is still repeated, and some slight difference of opinion is naturally good for trade. Meantime it should be well understood that 12-bore equals ·729 inch, and 16-bore ·662 and 20-bore ·615. The intermediate size represents a reduction of ·067 inch in the diameter, and the small 20-bore ·114 inch. According to these figures the change to 16-bore seems a large jump, to 20-bore very large. The cubical capacity of the cartridge provides an even more striking means of comparison. Taking $1\frac{1}{8}$ oz. as the medium shot charge of a 12-bore, the corresponding load for a 16-bore is $\frac{7}{8}$ oz., and for a 20-bore, say $\frac{3}{4}$oz. The first stage of reduction represents 18 per cent., whilst the 20-bore diminishes the charge by 29 per cent. From the point of view of gun weight the comparison is equally striking. To secure a recoil effect equal to a 12-bore firing $1\frac{1}{16}$ oz. charges and weighing 6lbs. 11 to 12oz., the 16-bore should weigh 5lbs. 11oz. and the 20-bore 5lbs. 1oz. The 16-bore thus represents an 18 per cent. reduction of charge and 1lb. of gun weight, whilst the 20-bore shows nearly a third reduction of shot in the cartridge, and $1\frac{3}{4}$lbs. in the gun. Tangible values such as these tend to show that it is slow work proving that the 16-bore will not carry 12-bore charges and likewise that the 20-bore must not be spoken of as though it fired a 16-bore cartridge. To complete the anomaly the 12-bore cartridge to which practical experience is mostly confined the struggle is the other way round, viz., to minimise the holding capacity of the case, in the hope of firing 16-bore charges out of a twelve.

The gunmaker has no other concern but to satisfy the fancies of his patrons, hoping meanwhile that fashions may some day change and present guns be rendered obsolete. The conservatism of the man who shoots arises from the desire to increase to the greatest possible extent the tangible proofs of his marksmanship, and he is loth to adopt any changes which may knock off some few percentage points from his form. By a process of gradual experience the lighter charges have grown in favour, but their general extension has been to some extent checked by the widespread belief that velocity is a good thing of which it is impossible to have too much. Recent researches favour the somewhat revolutionary idea that pressure is the great desideratum and that high velocity should be severely discouraged. In other words the best powder is the one which gives the required 3-ton pressure with a velocity not exceeding 1,050 to 1,080 f.s.

The process of charge reduction proceeds notwithstanding the many indications that a limit has been reached. Hitherto the one-ounce charge has been regarded as the irreducible minimum for adoption by loaders on a large scale. Coned cases and special powders facilitate the use of light charges, but the loader is generally restricted so as to be unable to choose what seems to him the best way of achieving the required result. The powder is specified as also are other details which combine to restrict the opportunity of introducing special methods. The main trouble incidental to the use of charges lighter than one ounce in a 12-bore is that the pressure is inadequate and the velocity too high. If the gunmaker complains that he has no objection to high velocity the retort is obvious: let him build guns whose shooting remains good in the presence of such conditions. Of artificial means of increasing pressure the most obvious is to make a tighter cartridge so adding friction to balance the loss of the dead weight of shot over the powder. To effect this purpose a quite feasible plan is to adopt a heavy turnover, a method which has been carried out with conspicuous success, but not without such an amount of trouble as to discourage the recommendation of the plan to the notice of loaders in general. The wads supply another means of increasing pressure, but the difficulty in that connection is to know what system of wadding gives greatest promise of uniformly raising pressure whilst leaving undiminished the other good qualities of the cartridge. A mere addition to the thickness of the cards or felt will most certainly fail to counteract the tendency for diminishing charges to be characterised by decrease of pressure. The addition of extra powder increases velocity more than pressure, and so aggravates the evils. The various forms of freak wadding which have been used during recent years provide an apparent answer to the problem which has been presented. As a general rule these fail because in economising powder they increase pressure. What, therefore, ranks as an evil with fully charged cartridges may prove positively beneficial when the effect they produce is actually required. The chief trouble of course is the element of uncertainty that would exist. To overdo a good thing when the good thing is chamber-pressure in the gun is not to be lightly risked. Hence the need for something which everyone may use, and of the behaviour of which there may be no doubt. The wad materials whose effects are most notable as increasers of pressure are of a plastic nature, viz., rubber or compositions of the rubber substitute order. From the point of view of cartridge loading deficient lasting properties are a decided disadvantage. On the other hand if their use is well nigh necessary this slight objection must be allowed to remain in the knowledge that the large majority of specially loaded cartridges are used up during the season when they are loaded. Hollow cupped wads, known as Swedish, are reputed to have this same property of occupying space and enhancing pressure. All available devices and materials need consideration; and the satisfactory solution will provide a new argument in favour of the 16-bore.

THE CHAMBERING OF ·22 RIFLES

The constant expansion in the use of the ·22 long-rifle cartridge has resulted in the short length ammunition being relegated to a position of obscurity which is hardly justified by its great usefulness for indoor practice. The long-rifle cartridge has so many users and advocates that the quality of manufacture constantly improves, with the result that groups which were once considered good at 25 yards are now frequently made at 50 yards, whilst, strange as it may seem, even the 100 yards shooting at times achieves a standard which not so long ago was considered good at half the distance. These changes have been brought about by the development of smokeless powder as a propellant, and the favourable co-ordination therewith of the priming composition, the ductility of the cartridge case metal, and the form and seating of the bullet. Rifle makers have similarly applied a constantly increasing amount of experience to the adjustment of the various details which improve shooting, either in the direction of diminishing the liability to mishaps, or else by modifications in the chamber which result in more correctly guiding the bullet to take a uniform seating in the rifling.

In what may now be termed the old days of black powder everything turned upon the use of a propellant giving a soft fouling which did not cake in the bore and so cause erratic shooting. With smokeless powders this difficulty was avoided, but the new one of high pressure acting in a cartridge case, necessarily thin to give sensitiveness of ignition, came along. Methods of case manufacture, which were quite successful with the low pressures ruling with black powder, were found to give rise to a large proportion of bursts when smokeless was used. The investigation of the trouble was rendered doubly difficult by the contributory influence of the rifle. Just in fact as black powder gave the cartridge maker considerable latitude, so it also permitted the continued existence of defective manufacture and design in rifles. The cartridge maker could generally explain bad performances of his ammunition by pointing out that the rifles were faulty. The rifle maker could similarly answer the same class of complaint by bringing forward samples of ammunition with which his weapon performed uniformly well. Gradually the maker of cartridges began to associate each crop of complaints with some defect in the working of the cartridge case metal. These faults being thus located they were gradually eliminated, and complaints in due course became less frequent. An exactly parallel process of improvement was meanwhile taking place with regard to the rifles. Firing pins with badly shaped or unduly large striker tips were found to account for most of the bursts in a particular part of the head. Other defects were similarly located by a close examination of the cases which had gone wrong, and the workmen charged with the various operations were not slow to realise the importance of paying particular attention to these small details. The natural result of this process of co-operative evolution is duly reflected in the ever increasing accuracy of the target results obtained.

There is, however, one point in connection with the status of the short cartridge which is still in urgent need of settlement. The period of indoor shooting is rapidly approaching, and although the standard of indoor marksmanship is as a rule lower than that carried on in daylight there are still many who find the short cartridge inadequate to their needs. Nevertheless, in the interests of those who shoot under cover, and who are forced to diminish noise and smoke as far as possible the low power ·22 cartridge should be brought to a higher standard of perfection than it at present achieves. The precise lines of a satisfactory solution have not as yet been clearly defined. Probably the worst possible arrangement is the one by which short cartridges are fired in a long chambered rifle. The bullet inadequately fills the smooth bore front of the chamber along which it has to travel before encountering the rifling. The gases naturally get by in large quantities, and the front of the chamber is rapidly eroded away until an actual bulge effect is produced. The lack of proper fit allows the bullet to enter the rifling at all sorts of angles, with the result that it spins on a false axis, and in due course emerges from the muzzle with a wobbling motion highly destructive of accuracy. After a course of firing short cartridges the rifle becomes utterly unserviceable for the more powerful grade of ammunition. The bulged front of the chamber allows the case to expand forward, so that extraction becomes impossible. Accuracy also disappears, because the erosion extends sufficiently far forward to affect the lead or cone joining the chamber to the rifled bore.

Erosion when due to the impact of gases is apt to favour one spot more than another, with the result that the cavities which are formed become filled with the highly corrosive fouling which emerges from rim-fire ammunition. When the rifle is out of use the slower but more deadly corrosive process continues the injury initiated by the more momentary erosion process. In a very short period of service the cartridge chamber becomes indented with a number of small cavities into which the plastic cartridge case metal is moulded under the influence of the gas pressure. There is therefore, a double resistance to extraction of the fired shell, viz., the general bell-mouth expansion of the front of the case, and second, the engagement of the case metal with the minuter crevices in the chamber. The available remedies are fairly obvious, the most satisfactory being to order for indoor shooting rifles chambered exclusively for the short cartridge. Another remedy is the use of the compromise design of cartridge, in which the bullet is lengthened so as to make it a better fit in the chamber and afford it more effective guidance during the first stage of its movement. Another plan is to recognise that ·22 long rifle cartridges can already be divided into high-power and low-power. The King's Norton and " R " brands with a velocity of 1100 to 1200 f.s. belong to the former class, and the Winchester smokeless, with 800 f.s., to the latter class. The accuracy of the low power kinds of long rifle cartridge is only slightly inferior at moderate ranges to that of the more powerful brands. On the other hand they are much more accurate than even the best of the short cartridges. These then are the various alternative solutions of a difficult problem.

LECTURES TO YOUNG GUNMAKERS.

LIII.—THE STANDARDISATION OF THIN BRASS CARTRIDGES.

Conscientiously as the Gunmakers' Association carried out the standardisation of sporting gun chambers and cartridge sizes for paper cases, they never supplemented their labours by dealing with thin brass cases or "Perfects" as they are called when of Kynoch manufacture. To elucidate some of the points of comparison between paper and brass cartridge cases will form suitable subject matter for one of the series of lectures to young gunmakers, the more so because the resulting tables will no doubt prove serviceable for many years to come in supplying answers to questions concerning the loads for these little understood cartridges. The first essential was to procure a series of sample cases covering all the bores. These were in due course carefully measured and compared, one maker's lot with those of another, with a view to ascertaining whether any marked differences existed. Great similarity was found in respect to all the sizes except 14-bore. In this instance the external and internal diameters were in proper conformity with the adjoining sizes, but one case was so thick in the base that a measured ounce of shot reached to the same height as in a 16-bore, whereas with the other the base was equally exceptional on the thin side. This difference was duly noted because of the great influence which thickness of base exercises on the cubical contents of a cartridge case. Otherwise, harmonious and consistent series of specimens of cases and wads was available for the measuring processes essential for the ascertainment of standard dimensions.

The problem first and foremost requiring settlement was to allocate to each size of thin brass cartridge an internal diameter of tube, the same being proportional to the diameter of the wadding and also to the bore of the barrel. A large number of measurements were duly made, and it soon became apparent that a fairly uniform system ran through the series. Individual variations certainly existed. but these were ascribed to unavoidable differences in the processes of manufacture. It is well understood amongst cartridge makers that to ensure a correct fit of the card wad it is necessary in brass cases to cut a special size to fit each batch of cases. The convenient give and take of paper is absent with brass, and the margin is thus rendered so small that cases and wads must either be sent out at times a bad fit or the wads must be specially cut to suit the various batches of thin brass cases as they are delivered into stock.

Table I.—*Dimensions of Thin Brass Cartridges.*

Bore.	Corresponding decimal diameter.	Diameter front of chamber.	Measured diameter of perfect wads.	Thickness of tube wall.	Internal Diameter of thin brass case by calculation.
8	·835	·914	·888	·012	·885
10	·775	·845	·818	·010	·820
12	·729	·800	·775	·010	·775
14	·693	·763	·745	·009	·740
16	·662	·732	·711	·009	·708
20	·615	·685	·668	·009	·662
24	·579	·649	·622	·009	·626
28	·550	·614	·590	·009	·581
32	·502	·562	·542	·009	·539
·410	·410	·465	·442	·008	·444

The essence of the above table consists in the column of calculated internal diameters of thin brass cartridge cases. The calculation is not based upon any abstruse formula or deep research, but merely on the very obvious deduction that the exterior diameter of a thin brass case should be about ·005in. less than the minimum gun chamber, and that the interior of the cartridge tube must have a diameter less than the external by the thickness of the two walls of the same. In other words the internal diameter of a thin brass case is arrived at by deducting from the diameter at the front of the chamber twice the measured thickness of the cartridge wall, and ·005in. for the necessary toleration. The wad diameter necessitates a surplus of ·003in. on the bore of the case, so that the complete values of diameter may be stated in the following simple form :—

Table II.—*External and Internal Diameter and Size of Card Wad for Thin Brass Cartridges.*

Nominal Bore.	External Diameter of Case.	Internal Diameter of Case.	Diameter of Wadding.
8	·909	·885	·888
10	·840	·820	·823
12	·795	·775	·778
14	·758	·740	·743
16	·727	·708	·711
20	·680	·662	·665
24	·644	·626	·629
28	·609	·581	·584
32	557	·539	·542
·410	·460	·444	·447

The bore of barrel to suit the ascertained size of wad would follow the usual practice with sporting cartridges. The ordinary 12-bore wad for instance, measures ·738in., and the best size of barrel is about ·732in. With larger gauges the difference between wad and barrel is greater, and with smaller bores less. The precise system of boring adopted varies with different makers, there being several gunmakers who have paid great attention to securing a high standard of result from thin brass cases.

Having thus said practically all there is to say about the sizes of thin brass cartridges, and how they compare with the ordinary paper case cartridges the next point requiring consideration is the amount of charge which each cartridge will hold. According to the new system of settling cartridge loads, it is necessary to ascertain beforehand with absolute precision the amount of space which is occupied by any given charge of powder in every size of cartridge. For paper cartridges this work was completed, and the results were published in the issue of exactly a year ago. Two sets of tables were then given, one dealing with the powder and the other with the shot. By the simple process of adding the length of the powder column to the length of the shot column, each with sundry addenda, and comparing the total with the length of the case, the amount of space available for felt wadding was at once apparent. A number of specimen charges were published at the time in illustration of the new system of working, and although several charges were specified which had never been publicly re-

ported upon, subsequent experiments endorsed the arithmetical combinations, and were unfavourable to the charges previously in ordinary use.

The amount of space now available is insufficient to allow for giving the whole of the data necessary for calculating charges for thin brass cartridges. The complete treatment of the subject must accordingly be deferred till another month, but in the meantime the following particulars may be submitted :—

TABLE III.—*Base of Thin Brass Cartridge to Face of Powder (entirely uncompressed).*

42-GRAIN POWDERS.

8	10	12	14	16	20	24	28	32
Grs. in.	Grs. in.	Grs. in.	Grs. in.	Grs. in.	Grs. in.	Grs in.	Grs. in.	Grs. in.
74 1·21	48 ·95	44 ·98	40 1·01	37 1·02	31 ·98	24 ·91	17 ·81	12 ·72
75 1·23	49 ·97	45 1·00	41 1·03	38 1·04	32 1·01	25 ·93	18 ·84	13 ·75
76 1·25	50 ·98	46 1·02	42 1·05	39 1·06	33 1·03	26 ·96	19 ·87	14 ·79
77 1·26	51 1·00	47 1·04	43 1·07	40 1·09	34 1·05	27 ·99	20 ·90	15 ·83
78 1·27	52 1·02	48 1·06	44 1·09	41 1·11	35 1·08	28 1·01	21 ·93	16 ·86
79 1·29	53 1·03	49 1·08	45 1·11	42 1·13	36 1·10	29 1·04	23 ·96	17 ·90
80 1·30	54 1·05	50 1·10	46 1·13	43 1·15	37 1·13	30 1·07	23 ·99	18 ·94
81 1·32	55 1·07	51 1·11	47 1·15	44 1·17	38 1·15	31 1·10	24 1·02	19 ·98
82 1·34	56 1·08	52 1·13	48 1·17	45 1·19	39 1·17	32 1·13	25 1·05	20 1·01
83 1·35	57 1·10	53 1·15	49 1·19	46 1·22	40 1·20	33 1·15	26 1·08	21 1·05
84 1·37	58 1·11	54 1·17	50 1·21	47 1·24	41 1·23	34 1·18	27 1·11	22 1·08
85 1·38	59 1·13	55 1·19	51 1·23	48 1·26	42 1·24	35 1·21	28 1·14	23 1·12
86 1·40	60 1·15	56 1·20	52 1·25	49 1·28	43 1·27	36 1·24	29 1·16	24 1·16
87 1·41	61 1·16	57 1·22	53 1·27	50 1·30	44 1·29	37 1·27	30 1·20	25 1·20
88 1·43	62 1·17	58 1·24	54 1·29	51 1·32	45 1·32	38 1·29	31 1·22	26 1·23
89 1·45	63 1·19	59 1·26	55 1·31	52 1·35	46 1·34	39 1·32	32 1·25	27 1·26
90 1·46	64 1·20	60 1·28	56 1·33	53 1·37	47 1·37	40 1·35	33 1·28	28 1·30

33-GRAIN POWDERS.

8	10	12	14	16	20	24	28	32
Grs. in.	Grs. in.	Grs. in.	Grs. in.	Grs. in.	Grs. in.	Grs. in.	Grs. in.	Grs. in.
58 1·20	36 ·91	32 ·92	30 ·98	27 ·98	24 ·98	17 ·83	12 ·78	10 ·70
59 1·21	37 ·93	33 ·95	31 1·00	28 1·00	25 1·01	18 ·87	13 ·77	11 ·75
60 1·23	38 ·95	34 ·97	32 1·03	29 1·02	26 1·04	19 ·91	14 ·81	12 ·80
61 1·25	39 ·97	35 ·99	33 1·05	30 1·05	27 1·07	20 ·94	15 ·84	13 ·85
62 1·27	40 ·99	36 1·02	34 1·08	31 1·07	28 1·10	21 ·98	16 ·89	14 ·90
63 1·28	41 1·01	37 1·04	35 1·10	32 1·11	29 1·13	22 1·01	17 ·92	15 ·94
64 1·30	42 1·03	38 1·06	36 1·13	33 1·13	30 1·16	23 1·05	18 ·96	16 ·99
65 1·32	43 1·05	39 1·09	37 1·15	34 1·16	31 1·19	24 1·08	19 1·00	17 1·03
66 1·34	44 1·07	40 1·11	38 1·18	35 1·19	32 1·22	25 1·12	20 1·04	18 1·08
67 1·36	45 1·09	41 1·14	39 1·20	36 1·21	33 1·25	26 1·15	21 1·08	19 1·12
68 1·38	46 1·11	42 1·16	40 1·23	37 1·24	34 1·28	27 1·19	22 1·12	20 1·17
69 1·39	47 1·13	43 1·18	41 1·25	38 1·26	35 1·31	28 1·23	23 1·16	21 1·23
70 1·41	48 1·15	44 1·21	42 1·28	39 1·29	36 1·34	29 1·26	24 1·20	22 1·27
71 1·42	49 1·17	45 1·23	43 1·30	40 1·32	37 1·37	30 1·30	25 1·24	23 1·32
72 1·44	50 1·19	46 1·25	44 1·33	41 1·35	38 1·40	31 1·33	26 1·28	24 1·37
73 1·46	51 1·21	47 1·27	45 1·35	42 1·37	39 1·43	32 1·36	27 1·31	25 1·42
74 1·48	52 1·23	48 1·30	46 1·38	43 1·40	40 1·47	33 1·40	28 1·33	26 1·47
75 1·50	53 1·25	49 1·32	47 1·40	44 1·43	41 1·50	34 1·43	29 1·39	27 1·51

The method adopted in compiling the above tables consisted in weighing out a series of powder charges, say 20, 30, 40, 50 and 60 grains respectively. These were poured in due succession into one of the cartridge cases, and the height of the powder column was measured off in each instance. The values were at once set out on squared paper, and the process was continued until a series of curves had been drawn showing the length of column for every powder charge within very wide limits. One curve was compared with another, and where discrepancies occurred re-measurements were made and the errors were set right. In due course there emerged a complete series of harmonious curves, all duly related to one another and capable of bearing at every point the test of a fresh examination. The work was carried out with typical samples of 42 and 33-grain powders. One set of values was compared with another, and certain slight additional alterations were carried out in order that the space occupied by alternative charges of the two classes of powder should be uniform. That is to say 42 grains of one powder occupies the same 3-dram bulk as 33 grains of the other, and this ratio holds good throughout the series of the curves from which the above tables have been read off. The final result represents the hardest of the tasks which had to be carried out in connection with the standardisation of charges for thin brass cartridges.

The corresponding process with regard to the space occupied by the shot is rendered vastly more simple by its virtual incompressibility as compared with the powder charge, where variations of ·05 of an inch easily occur as a result of differences of manipulation. In the tables above given extraordinary pains have been taken to measure the space occupied by the powder as far as possible in its natural condition as it would pass from the loading machine into the cartridge case. The compression which is applied during the subsequent loading processes exercises great influence on the behaviour of the cartridges, and as compression is regulated to the amount of powder, wads and shot, it follows that this element of quality will be safeguarded by the use of the tables of which this is the first instalment. It is not of course suggested that the inherent difficulties associated with the burning of smokeless powder in brass cases will be removed, but these are certainly minimised by good loading.

That it carries the subject some instance further than every-day knowledge may be shown by the quotation of a few simple and obvious extracts from the tabulated particulars. The 12-bore perfect is a 10-bore cartridge so far as the interior size of the tube is concerned. Therefore the 49-grain charge of a powder of the 42-grain class for a 10-bore should be appropriate for a 12-bore perfect. The 10-bore cartridge is 2⅝ inches long. Therefore, 48 grains may be accepted as the approximate charge for a cartridge of the nominal 2½inches length. The space according to the table occupied by this charge is 1·08 inches. The powder charges occupying the same lengths in the smaller bores are :—14-bore, 44grs., 16-bore, 40grs., 20-bore, 35grs., 24-bore, 30grs., 28-bore, 26grs., 32-bore, 22grs. The whole of these values appear reasonably near to the charges known by experience to be right for the respective bores, and when the matter comes to be further considered other useful developments will no doubt be forthcoming.

ROUND THE TRADE.

The directors of the Roburite Explosives Co., Ld., have declared an interim dividend of 10 per cent. on their preference shares.

Mr. F. Marten Hale desires that it shall be mentioned that the exploitation of Mr. Luck's patented process for restoring stability to deteriorated explosive has been placed in his hands.

The catalogue of Messrs. Eley Bros. has just been issued in a new form which will be much appreciated on account of the improved size of the pages and the general superiority of the get-up and illustrations.

Mr. S. Soddy, till recently at Messrs. Curtis's and Harvey's Cliffe factory, has signed a contract with the Mexican Dynamite Company, and he was due to leave for their works near Durango in the middle of last month.

The Birmingham Small Arms Co., Ld., have declared a final dividend for the year ended July 31st of 5 per cent. and five shillings a share bonus free of income tax on the ordinary shares, making in all 15 per cent. The preference shares receive a final 2½ per cent., making up the usual five per cent. At the time of writing the balance sheet has not been received.

According to newspaper reports the reform of Turkish administration has resulted in the removal of most of the vexatious restrictions which formerly operated against the importation of various classes of goods. Explosives are mentioned amongst the materials to receive more favourable treatment, as also are sporting guns, revolvers and sundry other weapons not ranking as military in type.

An erratum note has been issued from the explosives department of the Home Office to the effect that the quantity of the explosive Ammonal, which appeared second on the list of permitted explosives with a consumption during the year of 1,134,806lbs., should have been 114,806lbs., which changes its position to thirteenth on the list. The classification of all explosives should also be altered so that the total for permitted explosives is 7,764,122lbs., as against gunpowder 13,935,395lbs.

Mr. Phil Plater, who had the satisfaction of making the extraordinarily high score of 391 out of a possible 400 at the 50 and 100 yards individual Olympic rifle competition, has been awarded a record certificate and a special gold medal by the British Olympic Council, as consolation for the disappointment arising from the disallowance of this fine score in consequence of a technical breach of rules in no way affecting the genuineness of the performance which, by the way, was accomplished with a Greener ·310 rifle.

The explosive dangers of chlorate of potash are discussed in a most interesting manner in Major Cooper-Key's report on the inflammation of this substance, which took place at Manchester on the 23rd of June. The enquiry is directed towards ascertaining whether carbonaceous matter in the form of dust, or similar accumulations could have become mixed with an oxidising agent of the kind which was stored in the warehouse where the explosion occurred. The general conclusion is that explosion, properly speaking, could hardly be considered to have occurred in so far that one or two barrels of gunpowder would have done as much damage as the 80 tons of chlorates and nitrates involved in this accident. The fire clearly originated by the friction of one of the men's boots on a mixture of chlorate of soda or potash and organic dust on the floor of the warehouse, the presence of this mixture being proved beyond question by the rapid spread of the flame when rubbed with the foot. Further, one of the explosions was undoubtedly due to the mixture of fused chlorate and varnish, and the other two were most probably caused by one or more barrels of chlorate, which had up till then been partly protected from the heat, falling into the heart of the intensely hot furnace resulting from wooden staves burning in oxygen.

Under the title of C. Hunt and Co., Ld., a company has been registered to carry on the gun business of the same name in Loveday Street, Birmingham.

It is understood that tenders for the machinery for making the Mark III. Lee-Enfield which is to be installed in the Australian rifle factory will shortly be invited by public advertisement.

Messrs. Charles Osborne and Co., Ld., have issued a notice to the effect that their London warehouse will be removed from Great Scotland Yard to new premises at 10 York Buildings, Adelphi. The change implies a rebuilding of the premises, whose old-world aspect and surroundings form an interesting link with the past.

In connection with the prospecus of the Steelite Explosives Co., Ld., Mr. D. J. Metcalfe wrote to the *Times*, on behalf of Messrs. Curtis's and Harvey Ld., stating that his company has manufactured an explosive, of which the main constituent is chlorate of potash, for several years, and as a matter of fact the explosive itself was authorised for manufacture by His Majesty's Home Office in 1901.

The London Small Arms Company are advertising an aperture sight provided with a slanting base which has been specially adapted for use with converted Martini rifles. It is fastened by screws tapped in the metal portion of the grip forming the rear end of the shoe or body. The pattern obviates the necessity to cut away the wood, and it further possesses the advantage of great rigidity of fixing seldom associated with aperture sights on Martini action rifles.

Captain H. Coningham, R.A., has issued his first special report as an inspector of explosives, the subject of which is the explosion of detonators at the factory of the Patent Electric Shot Firing Company of Newbold, Derbyshire. The accident, which resulted in injury to four women, was apparently caused by the friction set up in the effort to remove a piece of fuse which had become jammed in a detonator the actual ignition being caused by a streak of composition adhering to the interior of the capsule.

Major Cooper-Key, in his report on the explosion at Messrs. Curtis's and Harvey's Cliffe works on June 5th last, explains that the accident occurred in a hut which was being used for the filling of dynamite cartridges by means of a pump arrangement which is explained in detail. By a process of exhaustion the chief inspector arrives at the conclusion that the explosion was started by friction brought about by a piece of grit deflecting the piston from the straight downward course, thus causing a slanting blow on the cylinder. He acquits the Company of all blame for not having applied a leather face to the socket of the pump. On the other hand he considers that the Kieselguhr should have been sifted through a much finer sieve than the 12-mesh size used, 30 meshes being necessary for the elimination of grit of a dangerous size.

The Webley and Scott Company have made wonderful progress lately in connection with the introduction and sale of their proprietary gun. The reception accorded to it by the trade has been extremely favourable, everyone admitting the practical benefit which accrues to gunmakers from being able to offer for use abroad a sporting gun conceived on simple lines, and of which every part can be renewed without special fitting. The price again is one which, whilst allowing a fair margin of profit, enables the trader to supply at a price having great attractions for the colonist or other person proceeding abroad. These would-be owners of a gun are as hostile to the idea of purchasing a weapon with a derogatory title indicative of third-grade quality as they are incapable for financial reasons of purchasing the quality of gun their taste recommends. The proprietary gun has received a first-class name, and firms of high standing have endorsed its excellent qualities by giving it the certificate of their own added name. The proprietary gun has great prospects, and the name of Messrs. Webley guarantees that with increasing demand the high quality of the first models will certainly be maintained.

FRENCH GUNS AT THE EXHIBITION.

The exhibits of French firearms at the Franco-British Exhibition are in many ways extremely interesting. Owing probably to their somewhat out-of-the-way position in the Palace of Decorative Arts they do not seem to have attracted so much attention from visitors as might have been expected. The exhibitors are chiefly gunmakers of Paris and St. Etienne. Many of the guns shown are modelled with some approach to fidelity on English patterns, the Anson and Deeley system of cocking being frequently adopted, while side-lock guns, also cocked by the fall of the barrels, are numerous. With differences in minor details, these seem to represent, in France as in England, what may be described as standard types. A certain tendency, no doubt attributable to the desire for greater solidity, is shown to make the guns heavy at the breech. The mass of metal forming the body is in some cases sufficiently bulky to impart an appearance that to English eyes is rather clumsy, while side clips, cross bolts, top connections and bottom fastenings are elaborated to an extent suggestive either of a lack of faith in the stability of the guns or an expectation that violent powders may be used in them. It is to the French that we owe the drop-down breech loader, as the exhibit of *M.* Henry Rieger, successor to Lefaucheux, reminds us. In the wall case of Rieger firearms there is shown a Lefaucheux pin-fire gun of an early, although not of the actual first, type. In these guns the single grip fastening was admittedly imperfect. The doll's head, the cross bolt and other top fastenings remedied the defect. The actual fault, which was gaping at the juncture of barrels and action face during firing, has long ceased to exist in guns of the higher grades, and double snap bolts are found to serve the required purpose without reinforcements of any kind. Still, if French manufacturers prefer to make assurance doubly sure, there are many English gunmakers to keep them in countenance. Perhaps a more marked divergence is found in the fact that whereas the French breech fastenings are brought into much greater prominence than are those of the English makers, their safeties are less in evidence. Some of the guns have no safety devices whatever, and a simple trigger bolting safety seems to be all that in the majority of instances is considered necessary. Taking the gun exhibits in the mass the tendency to adopt the types approved in this country is distinctly marked.

A subsidiary tendency, which is very distinctly shown, represents an effort to depart from stereotyped lines, with the object of improving upon the ordinary pattern of drop-down gun. That in the French exhibits anything is to be seen promising to exercise a revolutionary effect in this direction cannot well be said. In a search for something differing altogether from a gun with dropping barrels a gun with barrels that do not drop is immediately indicated. The museums of arms are full of them and all that can be done is to improve upon ancient fixed barrel patterns in the hope that they may rival modern drop-down patterns. Two distinct models of double barrel guns with movable breech closures instead of movable barrels are shown. Perhaps the chief advantages possibly to be secured by the change are that extraction and ejection are simplified and the fastening of the breech block to the barrel may be more readily effected than is the case when the barrel has to be secured to the action. In neither respect is there now any glaring defect calling for remedy. The fixed barrel type in very many forms was tried in competition with the drop-down type more than a generation ago. Presumably the fittest survived, and if the former type is to be revived in the favour of sportsmen, as well may happen in the future, it must offer some tangible advantage. A hammerless ejector, with fixed barrel will in its most perfect state cock without entailing undue strain on the hand of its user, eject selectively and shoot satisfactorily. A drop-down hammerless ejector may do no more, but it can do no less. The inducement to alter the type is not, therefore, one that seems likely to make any general appeal. Another novelty, one that is not brought very prominently into notice by its makers, is an automatic repeater. Resembling somewhat in its general lines the Browning gun, it is operated by gas instead of by recoil, a piston, actuated by gas from the barrel, effecting the opening and closing of the breech, ejection of spent shell and reloading. In minor matters of design and ornamentation of guns of the drop-down type many interesting things are to be seen in the exhibits, and to these casual spectators appear to devote a good deal of their attention.

An exhibit by the Proof House of St. Etienne comprising charts, views and documents, and two displays of gun work and designs produced by students of the *Ecole Professionnel* and the *Ecole d'Art Industriel* are prominent features in the display. These are not of a comprehensive nature by any means, but enough is done to show that the education of recruits for the workshops of French gunmakers is adequately looked after, and to indicate the attention devoted by the St. Etienne Chamber of Commerce to the important work of their Proof House, which although its yearly total of proofs is not yet of great magnitude is very rapidly increasing in importance. Two exhibits by Messrs. Delhorme, and Chaux, both of St. Etienne, are devoted to gun stocks, the latter firm in particular showing nicely figured wood. Messrs. Didier et Cie in a large exhibit show examples of steel and damascus barrels with an interesting collection of various kinds of figured barrels and strips of metal illustrative of the processes of manufacture. Of more immediate interest is the method adopted by the firm in the construction of their modern steel barrels and the fitting of the lumps. Ammunition manufacturers are represented by the Société Française des Munitions, and the Cartoucherie Française, both firms having show cases filled with sporting and military cartridge cases. There is included also in the section a display of traps for animals and a case of fuses and fireworks, neither calling for particular mention here.

The gunmakers represented are fairly numerous and their displays are all well arranged. The *Manufacture Française d'Armes et Cycles* of St. Etienne show many varieties of the "Ideal" gun which they manufacture in various grades, with miniature rifles, the "Gaulois" pocket pistol and a considerable collection of other firearms. Bergeron and Girodet of St. Etienne show guns, rifles and pistols, and F. Roux has a smaller exhibit in which miniature rifles are conspicuous. Zavattero Freres, of St. Etienne, have a range of machine-made shot-guns, the cheaper qualities being interchangeable, and Clair Freres show, with other weapons, their gas operated 5-shot automatic shot-gun and a double barrel gun with fixed barrels opened by means of a top lever. The next case, that of *M.* Regis Darne, includes several examples of another fixed barrel shot-gun, the breech block in this case being opened and closed on an ingenious system of which a detailed description cannot in this brief survey be given. Messrs. Berthon Freres have a considerable display of sporting guns, and make a feature of an exhibit of locks, and *M.* Chobert of Paris gives pride of place to his neatly arranged system of "superposed triggers" which consists in placing the triggers one above instead of one behind the other. The firms of Flobert and of Gastinne Renette, of Paris, are also represented, the latter making a special feature of heavy and elaborately adorned duelling pistols. Other exhibitors are also included, who make of swords and sword sticks a greater speciality than they do of

firearms. Yacht cannons, pistols for use with wax bullets, specimens of gun engraving and some examples of highly decorated firearms are other features to be observed in the instructive and interesting display, which does much credit to the gunmakers of St. Etienne and Paris to whose combined efforts its existence is due.

GUN COTTON IN ENGLAND (1846-7).

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

Two interesting papers were published in England, shortly after Schönbein's discovery, on the subject of guncotton. Teschemacher's (1) paper is worthy of note because he proves from his experiments that it is nitric acid alone which, in the mixed acids, enters into the reaction in the formation of guncotton. Gladstone's (2) communication stands on the same basis as the work of Crum (*Arms and Explosives*, Sept. 1908) in its thorough chemical investigation of the composition and properties of guncotton. Teschemacher wrote as follows :—" In consequence of the discovery by Professor Schönbein of guncotton, and of the possibility of its substitution in many cases for gunpowder, I have been induced to enter into an examination of the mode of its formation and of its synthetical composition, principally with a view of ascertaining how far it would be likely to affect an important branch of trade—the production and value of saltpetre and nitrate of soda. The examination was not commenced with the view of publishing it, but some of the facts brought to light appeared to possess sufficient interest to lay before the Society. I must premise that the experiments relate only to the guncotton prepared by the process recommended by Mr. T. Taylor. Equal measures of nitric acid of sp. gr. 1·509, and of sulphuric acid sp. gr. 1·840, were mixed together, and constituted (No. 1) the acids used in these experiments. I dried 50 grs. of South American cotton (from La Guayra) over a water-bath, and found the cotton gave off 3·40 grs. of hygrometric water. The 46·60 grs. of cotton which remained after drying, I steeped in 487½ grs. of the mixed acids No. 1 ; the strong acids were in contact with the cotton about two minutes, and after squeezing well, the cotton was washed in water to free it from the acid : the quantity of water used was 5000 grs.

The strong acid squeezed out of the cotton weighed 113½ grs. (No. 2) leaving 374 grs. of acid (No. 3) to be accounted for, to make up the original quantity used. The cotton thus prepared was perfectly dried in the air over a water-bath, and was found to weigh 79 grs., being an increase of 32·40 grs. on the cotton used, equal to an increase of 69½ grs. upon every 100 grs. of cotton in its original state. To ascertain whether the cotton would absorb anything more, I steeped 25 grs. of the above cotton, after it had been washed and dried, in fresh acid (No. 1), but no increase of weight took place. I also steeped a fresh portion of cotton for three minutes in the same quantity of fresh acid (No. 1) ; it weighed after washing and drying 78 grs. ; a third portion was steeped for four minutes in one-third more acid than in the previous experiments, it weighed after washing 79 grs. ; so that it appeared that the cotton had taken up its maximum from the acid by the first immersion.

As these 32·40 grs. increase of weight were clearly derived from the 487½ grs. of the mixed acids, I made the following experiments to ascertain what alteration the acids had undergone. I neutralised 100 grs. by weight of the original acid (No. 1) by carbonate of soda, and found that it required 52·80 grs. of soda for that purpose. I found likewise that to neutralise the 113½ grs. of strong acid (No. 2) separated from the cotton required 58·52 grs. of soda, and that the remaining 374 grs. of acid to be accounted for, contained in the washings, required 170·30 grs. of soda for neutralization, making together 228·82 grs. of soda required to neutralise the 487½ grs, of acids No. 2 and 3, used for acting upon the cotton ; therefore, if 100 grs. of the original mixed acids (No. 1) required 52·80 grs. of soda as above for neutralization, 487½ grs. would require (if not acted upon by the cotton) 257·36 grs. of soda ; it however only required 228·82 grs. as above. The difference, 28·54 grs. of soda, is therefore equal to the acid which disappeared, or was taken up by the immersion of 46·60 grs. of cotton in the mixed acids. To ascertain whether a portion of each of the mixed acids, or only one of them, was taken up by the cotton, I added to the solution of the 100 grs. of mixed acids (No. 1) (neutralized by the soda) chloride of barium, and obtained a precipitate weighing 126 grs. of sulphate of barytes.

I also, in the same manner, precipitated from the solution No. 2, 165·40 grs. of sulphate of barytes, and from No. 3, of 374 grs. 449·30 grs. of sulphate of barytes, making together 614·70 grs. ; therefore, if 100 grs. of the original acids (No. 1) give 126 grs. of sulphate of barytes, 487½ grs. would give 614·25 grs. ; they gave, as above, 614·70 grs., showing that no portions of the sulphuric acid were withdrawn, but that it was a portion of the ingredients of the nitric acid alone that combined with the cotton. The quantity of soda neutralized by the acids (Nos. 2 and 3) was, as just stated, 28·54 grs. ; therefore, if 32 grs. of soda neutralize 54 grs. of nitric acid, 28·54 grs. of soda will give 48 grs. of nitric acid, the quantity of acid which disappeared, or was taken up by the cotton.

From what took place, the following may be deduced as its synthetical composition :—48 grs. of dry nitric acid, containing 35·66 grs. of oxygen, were decomposed by the 46·60 grs. of cotton, and 32·40 grs. were added to the weight of the cotton. It is probable that the mixed acids combined with a portion of the constituent water of the cotton, which was replaced by oxygen and nitrogen, in the proportions of nitric acid, as there was no appearance of the evolution of either nitrogen or oxygen in the formation of the guncotton. Its synthetical composition would stand thus :—

46·60 grs. of cotton deprived of
15·60 water, give

31·00 cotton without constitutional water, combined with
48·00 oxygen and nitrogen derived from the mixed acids

79·00 the weight of guncotton produced, equal to

39·25 parts cotton,
60·75 .. oxygen and nitrogen (nitric acid)

in 100·00 parts.

From these experiments we arrive at the following conclusions regarding the formation of this substance :—That as it requires 48 grs. of nitric acid, or its equivalnet 90·66 grs. of saltpetre, to form 79 grs. of guncotton, it will require 60·75 grs. of nitric acid, or its equivalent 114·76 grs. of saltpetre, to form 100 grs. of guncotton ; and according to the same calculation, it will require 97·76 grs. of nitrate of soda for the same purpose.

Taking into consideration the original cost of the cotton, the expensive manipulation of the conversion of the nitre into nitric acid, and the additional weight of nitre required to produce the same weight of guncotton, it is evident that the latter substance must be more expensive than gunpowder, taking weight for weight of each. How far, however, guncotton may exceed gunpowder in its explosive force still remains to be ascertained, and this of course forms an important element in the calculation. Other processes may be already known, or may be hereafter discovered, calculated to reduce the expenses of the formation of the

so-called guncotton, but it must be still borne in mind that an enormous quantity of oxygen, amounting to 45 parts in every 100 parts of guncotton produced, must be obtained from some extraneous source for combination.

Many other vegetable fibres may be substituted for cotton; but as far as a few experiments which I have made, it appears they do not possess the explosive force of cotton. In a trial upon flax, I found that 50 grs. increased in weight to 72 grs.; the explosive force was feeble; this was the case with sawdust similarly prepared; but it is possible that this latter form of impure lignin may eventually be of more importance than it appears at present. Fifty grains of deal sawdust dried at 212° were first washed with dilute muriatic acid and then with dilute caustic alkali; they were found to have lost 6 grs. after washing and again drying. The 44 grs. remaining were steeped in the mixed acids for about five minutes, then washed and dried; they increased to 58·7 grs. The acids were examined by carbonate of soda in the manner before detailed, the sawdust was found to have neutralized 22·90 grs. of soda, equal to 38·65 parts of nitric acid, or 66·66 of nitric acid for every 100 parts of gun sawdust. This gun sawdust flashed off readily, but with less rapidity than guncotton, leaving a small carbonaceous residue. The difference in qauntity of nitric acid taken up by the sawdust and the cotton is no doubt owing to the former being a much more impure form of lignin than the latter."

Gladstone published the following work:—

"At the commencement of the present year, having perceived that considerable doubt rested on the ultimate composition of guncotton, I undertook a series of experiments with a view to ascertain it, if possible; and during my investigation my attention was drawn to various papers that appeared on the subject, where I found contradictory accounts, not only of the results of analysis, but also of the action of various reputed solvents. The experiments detailed below, although they are far from exhausting the subject, may serve to explain some of these anomalies, and to point out a few facts, which, as far as I have been able to learn, have not been hitherto noticed.

The cotton employed was that used by jewellers, well-carded, perfectly white, and free from imperfections. An analysis of the substance by combustion with oxide of copper in a stream of oxygen yielded the following results:—

Cotton employed	3·16 grs.
Carbonic acid produced ..	5·14 ,,
Water produced	2·06 ,,

These proportions are—

Carbon	44·37
Hydrogen	7·24
Oxygen	48·39
	100·00

Lignine calculated from the formula $C_{24}H_{20}O_{20}$:—

Carbon	44·44
Hydrogen	6·17
Oxygen	49·39
	100·00

The excess of hydrogen doubtless arises from moisture absorbed by the oxide of copper during the unavoidable delay in mixing it with the cotton. This cotton which may be considered as pure lignine, was steeped until thoroughly wetted in a mixture of nitric acid of sp. gr. 1·502, and nearly an equal bulk of strong sulphuric acid, then well washed with water, and dried at a temperature not exceeding 212° F. In one instance 38·38 grs. of cotton became 66·84 grs. being an increase of 28·46 grs., or 74·15 per cent. In a second experiment 59·3 grs. of cotton gave an increase of 43·7 grs. or 73·7 per cent. The guncotton, or pyroxyline, thus produced resembled the original cotton in physical properties very closely, and exploded at about 370° F, producing no smoke and leaving no residue.

The action of various solvents and reagents upon this substance was found to be as follows:—It is absolutely insoluble in pure water, and nearly so in strong alcohol, æther, whether hydrated or anhydrous, and in a mixture of æther with $\frac{1}{10}$ part of alcohol; but acetic aether instantly destroys its fibre, and dissolves it in large quantities. The solution yields on spontaneous evaporation a white powder of the same weight as the original pyrocyline, but I have found it very difficult to drive off the last traces of the solvent. The action of sulphuric acid upon it differs from that exerted upon unaltered cotton; for, while the latter is instantly dissolved by the strong acid, and charred upon a slight elevation of temperature, pyroxyline dissolves the difficulty unless the acid be warmed, evolving at the same time nitric oxide and other gases, and not being charred even upon boiling. With the aid of heat it dissolves immediately in a solution of potash. By means of these three last mentioned tests I was able to prove the absence of any unaltered cotton in the product under examination. The action of other reagents upon guncotton was not so decided; it was dissolved, but not without long boiling, by ammonia, the alkaline carbonates, hydrochloric acid, acetic acid, both glacial and dilute, and weak sulphuric acid. These solutions, as well as the two preceding, contained nitric acid; nothing could be precipitated from them by dilution or neutralization; and when evaporated they yielded only a dark brown amorphous matter. It is evident that none of these reagents restore the lignine in its original condition; and they do not afford any means of ascertaining whether the compound contains the elements of nitric or hyponitric acid.

As there exists a great discrepancy in the accounts given of the increase of weight in making guncotton, I examined whether the length of time it was immersed in the acid liquor, or the proportions of the acids employed, were the cause. The length of immersion I found to produce no alteration; but upon employing two measures of sulphuric acid to one of nitric acid, I obtained a product resembling in all respects ordinary pyroxyline, yet 42·77 grs. gave an increase of only 24·31 grs., or 56·84 per cent. Upon repetition of this experiment I found the increase to be 59·93 per cent., and again 70·6 per cent. Suspecting from the disparity of these results that something might be dissolved in the acid liquor, I immersed 6·7 grs. of cotton in a large quantity of the mixed acids, but it increased 4·9 grs., or 73·1 per cent. Perceiving that I had obtained an opposite effect to that anticipated, I treated 12·64 grs. of cotton with just sufficient of the mixture to wet it thoroughly: the fibre was evidently somewhat destroyed; the increase in weight was only 6·54 grs., or 51·74 per cent., and the acid liquor squeezed from the cotton, neutralized with ammonia, evaporated to dryness, and heated, gave abundant evidence of organic matter being present. Lest however it might be supposed that the whole had not been converted into pyroxyline, it was treated again with the mixed acids, but that produced an increase of only 0·12 gr. The action of various solvents confirmed its identity with ordinary pyroxyline, while its solubility in potash proved that the transformation had been very nearly complete. A repetition of the experiment gave similar results. It thus appears that the small increase in weight in the preparation of pyroxyline takes place when there is not sufficient nitric acid present to prevent the peculiar action of the sulphuric acid, namely, that of dissolving and altering it. When however the increase amounted to about 74 per cent., I was never able to detect the presence of oxalic acid or other organic matter in the acid liquor; and as no gas is evolved during the preparation of pyroxyline, it may be concluded that there is no secondary product containing carbon.

Subsequently, when Dr. Schönbein had specified his method of making guncotton, I treated 18·78 grs. of cotton with a mixture of three parts of sulphuric acid and one of nitric acid, sp. gr. 1·5, following his directions. The result was 32·92 grs. of a substance similar to that produced in former experiments, being an increase of 75·20 per cent. On another occasion 80·95 grs. of cotton gave an increase of 61·10 grs., or 75·47 per cent. The action of solvents and reagents confirmed the identity of this pyroxyline with that obtained in my previous experiments, and I was equally able to establish the absence of any secondary product containing carbon. In determining the ultimate composition of pyroxyline several precautions were found to be necessary. In the analyses recorded below it was cut into small pieces, and, after the weight was taken, mixed carefully with oxide of copper. To prevent its caking together the admixture of a little asbestos was found useful. This was introduced into a long combustion-tube, then some fresh oxide of copper, and upon it again some fused into lumps so as to fill the whole bore for about 7 inches. Lastly, was added a mixture of copper turnings and reduced copper for about 9 inches. The combustion conducted cautiously in the usual manner gave the following results; the pyroxyline burnt in the sixth experiment having been prepared by Schönbein's method.

	I.	II.	III.	IV.	V.	VI.
Pyroxyline employed ..	4·09	4·61	3·57	4·85	4·55	2·905
Carbo. acid produced . ..	4·20	4·52	3·42	4·88	—	2·84
Water produced	1·19	1·36	—	—	1·34	0·87

Hence in 100 parts,—

	I.	II.	III.	IV.	V.	VI.
Carbon	27·90	26·74	26·10	27·44	—	26·65
Hydrogen ..	3·22	3·27	—	—	3·27	3·32

In order to determine the amount of nitrogen the differential mode was adopted, as the method of *MM.* Will and Varrentrapp is inapplicable to substances containing this element in so highly oxidized a state. The same precautions were taken as in the estimation of carbon; and the collected gases gave the following results after due correction for barometrical pressure :—

	I.	II.	Another Specimen.
Carbonic Acid ..	25·0	38·5	23·9
Nitrogen	5·5	8·5	5·1

These proportions are.—

Nitrogen.		Carbonic acid.
1	:	4·55
1	:	4·53
1	:	4·68

The volumes of the gases represent respectively equivalents of carbon and nitrogen, and since no secondary product is formed in the conversion of lignine into pyroxyline, the 24 equivalents of carbon in the former must be found in the latter. This will give the following ratio in equivalents of carbon and nitrogen according to the three experiments above cited :—

	I.	II.	III.
Carbon	24·0	24·0	24·0
Nitrogen	5·28	5·3	5·12

or 24 : 5, which accords with the proportions assigned by *M.* Pelouze.* The formula which best agrees with these results is the following :—$C_{24}\left\{\begin{matrix}H_{15}\\5NO_4\end{matrix}\right\}O_{20}$, which reckoned to 100 parts, gives

Carbon	26·23
Hydrogen	2·73
Nitrogen	12·75
Oxygen	58·29

In order to compare pyroxyline with xyloidine, I treated starch with fuming nitric acid until the whole was converted into a gelatinous mass. The addition of water then threw down a white powder, which was subsequently well-washed and dried. The iodine test proved the absence of all unaltered starch. The xyloidine thus obtained explodes at about 360° F, leaving a carbonaceous residue. It is slightly soluble in æther, with which it is capable of forming a peculiar compound not yet investigated; more so in alcohol, but most of all in æther mixed with a small proportion of alcohol, or in acetic æther. It is dissolved by strong sulphuric acid without the aid of heat, and by boiling solutions of potash, ammonia, hydrochloric acid and dilute sulphuric acid. These solutions contain nitric acid, and nothing is precipitated from them by dilution or neutralization. Xyloidine is also soluble in strong acetic acid, or in nitric acid, whether fuming or of sp. gr. 1·25, but is reprecipitated from either by dilution. It was also found that nitric acid of ordinary strength (sp. gr. 1·45) answered equally well in the preparation of this substance; but when acid of sp. gr. 1·41 was employed no such result was obtained. Starch treatment with a mixture of equal measures of nitric and sulphuric acids produced a substance of greater combustibility, and more closely resembling pyroxyline, but differing from it in being soluble in glacial acetic acid, and in a mixture of æther with one-tenth part of alcohol, as also in the action that acetic æther exerts upon it. Xyloidine also when subjected to the mixed acids gave a product identical with the above, as far at least as the action of solvents can prove.

(*To be continued.*)

APPLICATIONS FOR PATENTS.

AUGUST 24—SEPTEMBER, 1908.

17,762. Explosive Grenades. F. M. Hale.
17,960. Explosive Grenades. F. M. Hale.
17,980. Bullets. L. B. Taylor.
17,982. Cartridges. T. P. Wood.
18,130. Sights. J. T. Peddie.
18,231.* Quick-firing Guns. Société Schneider & Cie.
18,319. Guns. W. E. Corrigall.
18,370.* Bullets and Projectiles. E. Spencer.
18,520. Maxim Gun Cartridge Feed. Vickers-Maxim and G. T. Buckham.
18,530. Sighting Apparatus of Field Guns. Vickers-Maxim and G. T. Buckham.
18,567.* Automatic Pistols. Webley and Scott, Ld., and W. J. Whiting.
18,630. Small Arms Ejector. B. Walker.
18,737.* Barrel Recoil Guns. Rheinische Metallwaren-und-Maschinenfabrik.
18,764. Charging Guns. A. E. Lester.
18,843.* Automatic Gun Breech Mechanism. A. Vickers.
18,849.* Machine Guns. A. J. Boult.
18,934. Targets. S. G. Cater.
19,045. Target. J. R. Rowland.
19,102.* Drop-down Small Arms. R. Hill and J. V. Smith.
19,132.* Barrel Recoil Guns. Rheinische Metallwaren-und-Maschinenfabrik.
19,177. Small Arms. W. J. Whiting.
19,269.* Range Finders. A. W. Erdman.
19,327. Cartridges. T. P. Wood.
19,334.* Explosive Compounds. J. E. Holmes.
19,345.* Projectiles. Fried Krupp.
19,404.* Automatic Pistols. O. H. J. Krag.
19,417. Air Guns. R. B. Gilbert.
19,445. Air Guns. A. H. Hill.
19,451.* Gun Sights. F. L. Putney.
19,537.* Magazine Rifles. J. Hylard.
19,620.* Cartridges. H. Whittington.
19,721. Rifles. T. R. R. Ashton.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

AUGUST 20—SEPTEMBER 17, 1908.

COMPILED BY HENRY TARRANT.

10,510 (1907). **A New Explosive.** B. E. D. Kilburn, London (Agent for *W. Reckmers, Germany*). (*See Selected Patents*)

13,394 (1907). **Projectile Construction.** F. Pritzkow, Germany. For known reasons a hollow part is sometimes attached to the rear end of an ordnance projectile. To facilitate the use of this the patentee so shapes it that the gas exerts an equal pressure on both its outside and inside walls. This hollow part may also be perforated. Accepted Aug. 10, 1908.

15,917 (1907). **New Form of Air Gun.** C. G. Bonehill and H. Horner, Birmingham. The spring of the air gun dealt with in this patent is compressed by pulling the barrel and cylinder upwards on a hinge situated in front of the top of the grip. It is claimed that it is much easier to use this form of rifle when shooting in the prone position and that a much more sure engagement is obtained between sear and plunger than in other air rifles. Accepted Aug. 11, 1908.

18,638 (1907). **Target Practice Apparatus.** F. Mitchell, London. Apparatus is attached to a rifle whereby the discharge of the cartridge is prevented should the rifle be directed wide of the distant target. The degree of accuracy of aim is indicated by apparatus of the type described in patent No. 15,500, 1908. Accepted Aug. 17, 1908.

18,879 (1907). **Target Practice Device.** F. Mitchell, London. The aiming teaching apparatus dealt with in this patent is of the type in which a rod is adapted to follow the movements of the rifle the movements of the rod being indicated on a miniature target by a magnifying pointer. This apparatus is improved to allow the rifle free angular movement beyond that of the rod to which it is connected. Accepted August 20, 1908.

18,941 (1907). **Automatic Ordnance.** O. Imray, London. (Agent for *Rheinische Metallwaaren und Mf. Germany*). In quick firing guns in which the barrel is normally closed by a breech fixed to the carriage and which is capable of being advanced and then returned by a spring, a special form of brake is used to control the energy of the forwardly moving barrel. Loading arrangements are also dealt with. Accepted August 24, 1908.

21,883 (1907). **Howitzer Sighting Apparatus.** E. Schneier,d France. Sighting apparatus for howitzers is carried by a shaft running parallel with the trunnions, and consists of two mechanisms—one for giving angle of elevation, and the other for direction. All operations carried out by similar apparatus may it is claimed be effected with these mechanisms which have a smaller number of parts and occupy less space. Accepted August 6, 1908.

23,654 (1907). **Depression Control Gear for Heavy Ordnance.** A. F. Petch, and F. Duncan, London. Hitherto a cam rail has been provided to prevent the depression of heavy ordnance below the danger zone, *i.e.*, when the projectile if fired would strike intervening objects. The patentees provide in lieu of this rail an automatically operated valve which causes the gun to be raised at minimum elevation speed to bring the line of fire out of the danger zone should it be depressed too far. Accepted August 13, 1908.

24,094 (1907). **Self-loading Barrel Recoil Ordnance.** Fried. Krupp, A.-G., Germany. In self-loading ordnance in which the cartridge is brought up in the rear of the gun barrel by a feeding device and then introduced by an advancing member, the accumulator which operates the loading device acts directly upon the advancing device only, whilst the feeding device is brought into position by the movement of the parts which effect the advance of the cartridge. Accepted August 20, 1908.

24,413 (1907). **Howitzer Sighting.** A. F. Petch and R. Redpath, London. The axis of the sight more especially of howitzers and high angle firing ordnance is inclined in two directions to the horizontal and vertical planes in which the gun works to automatically compensate drift. Accepted August 20, 1908.

24,837 (1907). **An Air Pistol.** E. Anson, Birmingham. (*See Selected Patents*).

24,887 (1907). **Breech Connection for Breakdown Guns.** F. Jaeger, Germany. (*See Selected Patents*).

24,915 (1907). **Range Finders.** C. Pulfrich, Germany. The telemeter described in this patent is an improvement on that dealt with in American specification 519,319. The instrument is used for two successive observations the telescopes being combined so that the same ocular serves for both observations. Accepted August 20, 1908.

25,220 (1907). **Ammunition Hoists.** Lieut. A. T. Dawson, London, and J. Horne, Barrow-in-Furness. Hoists of the kind dealt with in Patents Nos. 4,617 and 9,415, 1899 are improved, the principal object of the invention being to provide a more convenient arrangement for loading the powder charges to the hoisting cage. A rotatable bogie similar to that for projectiles is provided for powder charges. Accepted August 27, 1908.

351 (1908). **Ammonium Nitrate Explosives.** H. J. Hadd n, London. (Agent for *F. J. Lehmann, Germany*). Solid cartridge and blasting charges are moulded or shaped by pressing mixtures of ammonium nitrates explosives with nitrocellulose dissolved by a volatile solvent. Ammonium nitrate explosives are also pressed into shape with normally solid nitro-hydrocarbons dissolved by a volatile solvent with or without admixture of nitrocellulose similarly dissolved. Such an explosive is claimed to be non-hygroscopic. Accepted July 30, 1908.

1,912 (1908). **Projectile Head.** R. G. May, Channel Islands. A corrugated shaped screw extends from the beginning of the projectile head towards the points and is provided to help the projectile to penetrate armour plates. The pitch and depth of the screw threads and the distance from the nose varies according to the size of projectile, the velocity and twist of rifling. Accepted August 20, 1908.

2,882 (1908). **Breakdown Air Gun.** H. W. Lake, London. (Agent for *Daisy Manufacturing Co., U.S.A.*). In order to divide the work of "cocking" a break down air gun, the spring is compressed forwardly instead of rearwardly when the gun is opened and the compressed spring and plunger together are drawn rearwards when the gun is closed. The gun has of course travelling trigger mechanism to allow of this. Accepted August 20, 1908.

3,510 (1908). **Air Rifle Target.** C. H. Ross, West Bromwich. A target such as is used by air rifle clubs is provided with a disc which is automatically exposed to view when a pellet passes through the bull's-eye hole in the target plate. The movement of the disc and its rod operates a part which strikes a bell. Accepted August 20, 1908.

3,568 (1908). **Revolver Holster.** F. H. Audley and J. Beveridge, U.S.A. A holster is provided with a pocket to receive the barrel and cylinder of the revolver and with spring devices at back and front to prevent accidental displacement of the weapon. The holster is also provided with a device adapted to hold it in the pocket of a garment. Accepted August 6, 1908.

4,634 (1908). **Cartridge Carrier.** A A. Woodhouse, India. A number of metal loops receive a strap. The strap may be pulled out between each of these loops so that a cartridge of any size may be inserted and securely held. A small metal device is used to pull the strap out into loops. Accepted August 6, 1908.

5,217 (1908). **Sporting Gun Sights.** D. D. Harris, U.S.A. A spring clip device having a bead on either side of its top is attached to the forward part of the barrel of a sporting gun. These beads are used in conjunction with a peep back sight so that allowance for a moving object is made whilst the shooter holds "dead on." Accepted August 20, 1908.

6,030 (1908). **Recoil Absorber for Small Arms.** J. Hagmüller, Germany. The butt plate described in this patent is pressed outwards beyond the actual stock end by a spiral spring. The recoil forces the two together against the spring pressure and a hook arrangement holds them so. By touching a button the hooks are disengaged. Accepted August 27, 1908.

6,074 (1908). **Rifle Back Sights.** J. F. Peddie, London. In order to obtain fine adjustments for elevation the patentee forms the edges of an ordinary tangent backsight leaf independent of the leaf proper. The sight slide is gripped on to these parts by spring pawls so that the slide may be very finely moved up or down the leaf by means of a screw which operates the independent edge parts. The spring pawls may be pressed outwards to disengage the slide from the leaf edges to allow of rapid elevating adjustments. Accepted August 20, 1908.

7,938 (1908). **Attachment for Sporting Gun Stocks.** J. F. Beck, U.S.A. (*See Selected Patents*).

8,516 (1908). **Bullets for Shot Guns.** G. Brewer, London (Agent for *J. Lyon, Calcutta*). A spherical, built up bullet is adapted for use in either cylinder or choke bored shot guns. Intersecting steel discs circular in shape form the internal structure of the otherwise leaden projectile. Accepted August 27, 1908.

10,222 (1908). **Automatic Pistol Mechanism.** A. W. Schwarzlose, Germany. The removal and replacement of the barrel of this automatic pistol is facilitated by arranging that the guide bolt for the closing spring serves also as a barrel retainer. The barrel is removed simply by tilting the bolt. Accepted August 6, 1908.

10,268 (1908). **Ejector Mechanism for Shot Guns.** F. S. Cox, Birmingham. This mechanism is adapted for a single barrelled break down gun. As the gun is opened a sear holds the extractor leg which has compressed a spiral spring during the closing movement. At a certain moment the sear is disengaged from the leg and the spring jerks the extractor outwards. The movement of the ejector is limited by a second bent or nose on the sear. The mechanism is contained beneath the barrel end and is accommodated in the action body when the gun is closed. Accepted August 20, 1908.

10,297 (1908). **Projectile Fuse Construction.** E. Schneider, France. The construction of this double action fuse permits of the arrangement of all the parts round an axial striker and of the utilization of the latter as a step bearing for the drum of the regulating mechanism. The striker is normally retained in its operative position by a ring which on shock of discharge moves into a position to compress a spring cocking the striker so that it will operate to fire the priming after the expiration of the interval of time determined in setting. Accepted August 6, 1908.

11,319 (1908). **Detachable Lock Plates for Double-barrelled Guns.** H. W. Holland, London, and T. Woodward, Willesden. (*See Selected Patents*).

11,999 (1908). **Self-propelling Projectiles.** Lieut.-Col. W. T. Unge, Sweden. In self-propelling projectiles such as rockets an opening is arranged in the nose to allow of ignition of the motive composition from the front end. The composition has been hitherto ignited from the rear. Accepted August 13, 1908.

12,778 (1908). **Travelling Ordnance Carriages.** Fried. Krupp, A.-G., Germany. In order to take up strain of recoil when the gun is fired in extreme lateral positions, struts with spades are provided which may be swung to either side of the main trail. Accepted August 20, 1908.

12,779 (1908). **Wheeled Ordnance Carriages.** Fried Krupp, A.-G., Germany. The spade of the trail is pivoted so that by moving the wheels of the carriage about a vertical axis the gun may be shifted in a circular fashion without taking the spade from the ground. Accepted August 20, 1908.

12,851 (1908). **Ammunition Rammers for Ordnance.** Fried. Krupp, A.-G., Germany. The rammer in its usual form has a heavy head consisting of a compact wooden disc. Heavy headed hand rammers are difficult to manipulate and the patentees provide therefore instead of the wood discs heads of bent strips of elastic resisting material such as steel. Accepted August 6, 1908.

15,195 (1908). **Blasting Explosive.** W. Eberle, Germany. A new explosive, for which is claimed the capability of breaking up rock without appreciable splintering, is composed of saltpetre or nitre, sulphur, charcoal and horse dung dust mixed in the ratio of about 12 : 3 : 1 : 1 respectively. Patents Nos. 13,822, 1897 and 18,516, 1899, are mentioned as dealing with compounds of a similar character. Accepted August 27, 1908.

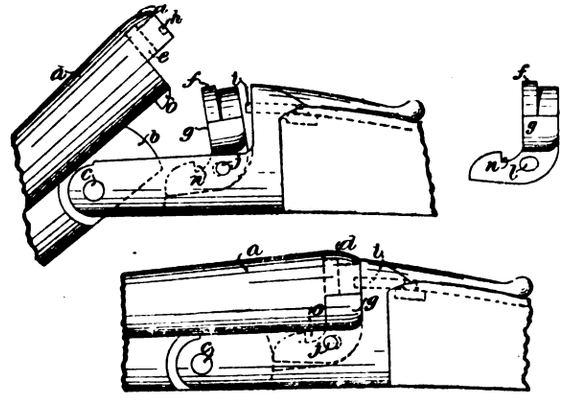
15,500 (1908). **Target Practice Apparatus.** F. Mitchell, London. Target practice apparatus is described in which the gun is moved freely without actuating the indicating mechanism until the firing action actually takes place. Reference is made to Patent No. 18,638, 1907. Accepted August 17, 1908.

SELECTED PATENTS.

BREECH CONNECTION FOR BREAK-DOWN GUNS.

24,887 (1907). F. Jaeger. Germany. The first claim of this patent describes the scope of the invention :—"In a gun with a break-down breech action and with a separate block supported in the breech part so as to close against the barrel ends when the breech is closed, the arrangement wherein the said block is so supported by a slot and pin or a link or the like, that the block can come into position vertically against the rear ends of the barrels so that it will take the shock of explosion and will prevent said shock coming upon the connection between the barrels and the stock."

On the underside of the pair of barrels *a* is the lug *b* working about the joint pin *c* of the action in the usual way. The rearward extension *d* is provided with grooves *e* which are designed to close over and engage in locking relation with the lugs *f* on the "closing block" *g*. The end of the extension *d* carries the usual form of notch *h* into which part of the closing bolt *i* enters when the gun is closed.



The closing block *g* rocks on the pivot *j* which works in the slot *l* so permitting of a longitudinal as well as a rocking movement. The block *g* also carries the hook *p* into which the nose *o* on the barrel is adapted to engage.

During the last part of the closing movement of the gun the face of the closing block *g* is exactly perpendicular to the bore of the barrel, and when completely closed the hook *n* and projection *o* engagement, and the close fit of the cap *d* over the top of the closing block *f* and the interlocking of these two parts are claimed to make a very secure breech connection, the closing block taking all the shock of explosion.

The slot *l* and pin *j* combination may be replaced by a link connection. Accepted July 30, 1908.

A NEW EXPLOSIVE.

10,510 (1907). B. E. D. Kilburn, London. (Agent for *W. Rickmers, Germany*). A new explosive claimed to possess certain advantages over those now in existence is dealt with in this patent. It comprises a mixture of an organic substance with certain salts rich in oxygen.

The patentee has discovered that the group of organic substances containing tannin is suitable for use with the salts referred to above. The members of this group contain a large proportion of hydrogen and carbon and are also rich in oxygen. Myrobalans are stated as members of the group to be particularly suitable for use with oxygen salts, probably because it contains a considerable quantity of ellagotannic acid. Divi divi

and valonia are also stated to be capable of producing good results.

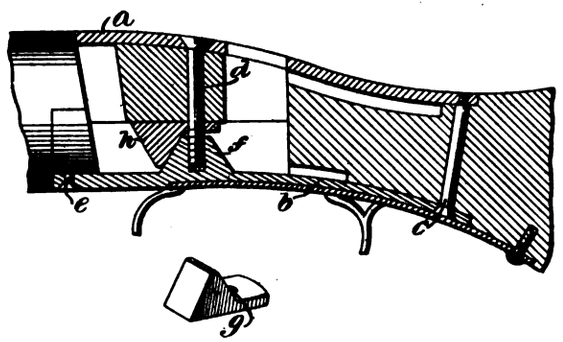
An oxygen salt that may be used with either of these substances is perchlorate of ammonia with which may be mixed saltpetre or nitrate of ammonia. An example of these salts in combination is crushed myrobalans, 36 parts, powdered saltpetre 29 parts, powdered perchlorate of ammonia 35 parts. The flame temperature of such a mixture is said to be low so that the explosive can be used safely in a mine in which fire damp or coal dust are dangerous attendants.

Agar-agar is mentioned as a good binding medium for the ingredients of the above explosive, which is claimed to be very powerful and quite safe to handle or tamp. Accepted Aug. 6, 1908.

ATTACHMENT OF SPORTING GUN STOCKS.

7,938 (1908). J. F. Beck, Senr., U.S.A. The secure and firm attachment of sporting gun stocks to their actions is the object of this invention. By means of a wedge and "tie-bolt" the action is always forced back into the wood. The illustrations here reproduced show the construction clearly.

The action tang *a* extends rearwards in the usual way, and the stock is secured between this extension and the trigger plate *b* by the pin *c* and the tie-bolt *d*. The front of the plate *b* is held by the pin *e* which enters the action body.



The tie-bolt *d* projects through a hole in the tang *a*, runs through a hole in the stock and enters the lump *f* in the trigger guard after passing through the hole *g* in the rearward extension of the separate wedge "bolster" *h* made of metal. This bolster and the wedge-shaped lump *f* of the trigger plate combine to lock the stock and action in proper position.

In stocking and "screwing" a gun the relative positions of action and stock are first secured by wedging the one into the other through the parts *f* and *h*. The hole for the stock pin is then bored. Accepted July 30, 1908.

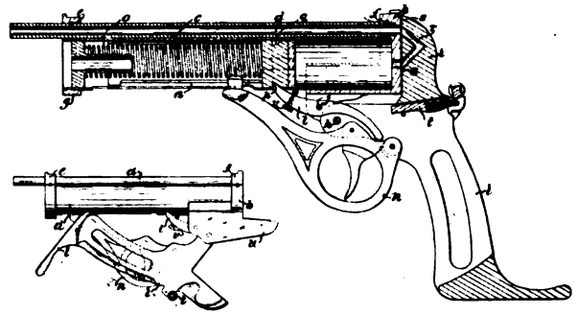
AN AIR PISTOL.

24,837 (1907). E. Anson, Birmingham. Reference to the drawings appearing in the text of this description will at once convey a clear idea of the construction of this air-pistol. The cylinder containing the plunger and spring is situated beneath the barrel. The spring is compressed by breaking down the barrel and butt so pushing the plunger towards the muzzle. The push of the spring is delivered, when the trigger is pulled, towards the breech.

The plunger cylinder *a* is secured at one end to the shoe *b* and receives the plunger *c*. The axes of the cylinder *a* and barrel *d* are parallel and the barrel is secured to the plunger by the pins *e* and *f* the one in the front support *g* and the other in the "shoe" *b*, which carry the front and back sights respectively. The shoe *b* also carries by the pivot attachment *h* the butt or handle *i*, and by the pivot connection *j* the sear *l*. The trigger guard *n* is the link through which the plunger is forced against the pressure of the spring *o* towards the muzzle end when the butt is turned downwards on its pivot *h*. When the plunger has been forced back a certain distance, the nose *p* of the sear *l* catches in recess *q* in the plunger head and holds the plunger in the "cocked" position. The butt may then be turned back to its normal position. It will be noticed on referring to the smaller drawing of the two that the trigger guard enters a central slot in the butt when the latter is pulled down to "cock" the pistol.

The conduit *r* in the head of the handle *i* forms the channel through which air forced by the plunger *c* from the cylinder *a* enters the barrel *d* the leather pads *s* being attached to the frame to prevent leakage of air at the breech joint.

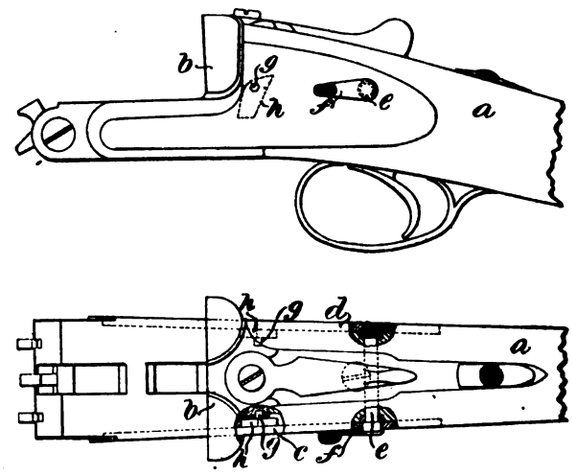
When cocking the pistol the butt is turned down on its pivot and is forced nutcracker fashion towards the underside of the cylinder. The back wall of the plunger recess *q* is forced into engagement with sear nose *p* and the butt is turned back to its



original position, being held there by the spring controlled snap bolt *t* whose members engage with the projecting shoe portion *u*. A pellet is placed in the breech of the barrel when the weapon is broken down, and when the trigger is pulled after the arm is closed compressed, air is forced against the rear of the pellet so that it is discharged from the barrel. The screw *v* is provided to regulate the strength required to disengage the sear and recess. Accepted August 27, 1908.

DETACHABLE LOCK PLATES FOR DOUBLE-BARRELLED GUNS.

11,319 (1908). H. W. Holland, London, and T. Woodward, Willesden. In order that the locks of a double barrelled small arm may be easily dismounted for inspection or cleaning, a bolt is passed from a hole in one lock plate right through the stock to a hole in the other. One end of the bolt is threaded to screw into one lock plate whilst the other end carries a lever by means of which the bolt is readily turned into position. The lock plates are properly "positioned" by studs engaging in the action body.



The stock *a* and action body *b* are of the usual form, whilst *c* and *d* are respectively the left and right-hand lock plates. The fixing bolt *e* is threaded at one end so that it may be screwed into a tapped hole in the lock plate *d*, whilst the lever *f* is used to turn the bolt into the hole. The studs *g* are provided on the nibs *h* and take into holes in the action body *b* to prevent any movement of the lock plates should the stock shrink or the hole through which the bolt passes become enlarged. Accepted August 20, 1908.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 194.—Vol. XVI. NOVEMBER, 1908. Monthly, Price 6d. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

Shooting Prospects.—Inasmuch as the grouse and partridge results have not reached the high level originally anticipated it now rests with the pheasant and the rabbit between them to elevate the present shooting season to at least a normal standard of cartridge consumption. The statistics within the trade itself are necessarily of a discouraging nature, because the retailer has developed caution by reason of the surplus stocks which have been left on his hands in previous bad seasons. Particularly was this the case a year ago. The impression of cautiousness in ordering new stocks is confirmed by the scarcity of work amongst the wholesale gunmaking houses. Although pheasant shooting nominally commenced on the first of October, game preservers continue to do less and less shooting on the boundaries, confining themselves to just so much disturbance of the outlying coverts as will suffice to drive the birds to the better protected woods in the centre of the estate. These are merely causes whose general effect is to throw pheasant shooting later and later, so that the greater part of the birds may be shot under the best sporting conditions. Whilst partridges have been patchy, the pheasant appears to have done uncommonly well on all sides, especially the wild bred birds which have to shift for themselves. The invitations for covert shooting which are issued at about this time of year frequently contain advice concerning the number of cartridges likely to be required, the advice being naturally based upon the quality of the sport in prospect. The trade at once responds to the orders which follow, and there have been indications for some weeks past that the demand is unusually brisk for the time of year. Rabbits, to a smaller extent than pheasants, are also shot later in the season. The mild autumn has accentuated the reasons for postponement, and in so far that the rabbit in many instances occupies the same quarters as the pheasant, the delay that affects the one must also react upon the other. Therefore, whilst no season can possibly be good which shows indifferent results with grouse and partridges, it is cheering to know that the better half of this particular season has still to come.

The Proof Act in Scotland and Ireland.—It is interesting to know that the Gunmakers' Association have expressed hearty approval of the proposal to include Scotland and Ireland in the working of the Proof Act. The Board of Trade have been approached on the subject, and it is understood that they view with favour the proposal to extend to these two portions of the kingdom the whole of the provision as regards proving of guns which now apply to England alone. There is absolutely no logical reason why all sections of the kingdom should not be treated as one in a matter which affects everybody alike, and the position is rendered positively absurd by the circumstance that gunmakers in Scotland and Ireland observe the provisions of the Proof Act just as though they were obligatory in all quarters of the kingdom. An exception admittedly occurs in the case of small rifles and other inexpensive firearms which are imported directly into these countries without a preliminary visit to one or other of the two proof houses. The Gunmakers' Association in their circular to the trade justifiably lay stress on the inconveniences which may arise when such weapons are later on taken to England, thereby introducing the risk that they may be illegally sold. It is naturally open to anyone to suggest that a Proof Act cannot in justice be forced upon countries like Scotland and Ireland without

making provision for the establishment of local proof houses. The voluntary acceptance of the proof test concerns the individual alone, and it does not debar him from opposing a statute making the same thing compulsory. In the interests of the public there is no doubt that all arms should, without exception, be properly proved before issue to the purchaser, and practical policy suggests that the work of proving guns should not be further decentralised than at present. Some extra cost would certainly be entailed in sending to proof guns which have previously passed into use without the test, but the purchaser should not begrudge the slight extra cost entailed. It must, however, be remembered that the Birmingham gunworkers wrecked by their opposition a most important revised edition of the Proof Act, because they were denied concessions by no means vital to the provisions of the bill before Parliament. A large quantity of money was spent all to no purpose, in the promotion and opposition of the bill. The present proposal is to pass as an unopposed bill a simple enactment, having but one object in view to which no right-minded person should object. Absolute unanimity will be practically essential if the Bill is to pass at a time when public business is already in a state of congestion. It is, therefore, to be hoped that the two Gunmakers' Associations will arrange between them that all sections and individuals are united in approval of the bill which Mr. Jesse Collings proposes to introduce to the House of Commons at a favourable opportunity.

Our Lecture on Thin Brass Cartridges.—The attention of all grades of gunmaker is particularly drawn to this month's lecture, in which an altered system of tabulation has been adopted for the better display of the modern principle of determining sporting cartridge loads on the basis of the space occupied by the respective items in the charge. Thus no matter what quantity of powder and charge of shot are specified for any given calibre of cartridge a single square inch area of table will enable anyone interested to state precisely what length they will occupy in the cartridge case, and by deduction what size of felt wad is necessary for properly filling the case, the best conditions of loading being then assured. The vital importance of the new principle consists in the power it gives to control the loads of some of the less understood cartridges by means of information derived from the other sizes in popular demand. It is for instance, a first principle of loading that 1 ¼ oz. is a useful medium charge for a 12-bore. The equivalent for 16-bore is at once fixed by the tables at $\frac{15}{16}$ oz. and for a 20-bore at $\frac{13}{16}$ oz., and so on for the other sizes. The process of tabulation which was originally adopted when dealing with paper cartridges was not so convenient for reference as the one now presented in connection with thin brass cases is expected to prove. In due course the improvements now introduced will be extended to the other cartridges, but meantime the loading of thin brass cartridges is greatly facilitated and their shooting results will no doubt be correspondingly improved by the circulation of definite statistics concerning the exact capacity of the various cartridge sizes in terms of powder and shot. The process of examining a suggested load consists in adding the measurement of the powder to that of the shot, and deducting the total from the length of the cartridge case. The practicability of the combination from the loading point of view is at once disclosed, and if a mistake has been made, say the charge for one length of case having been mistakenly quoted as appropriate for another length, the necessary readjustment can be effected before any materials have been wasted. The power to manipulate the values to take into account such matters as variations from the standard of card wadding assumed to be used is readily acquired with a little practice. The system in fact merits careful study, not necessarily as a substitute for existing methods, but as a supplementary and preliminary theoretical test.

A Census of the Explosives Trade.—The schedule in connection with the first census of production of the United Kingdom has just been issued to explosives manufacturers, who are required by law to supply the particulars demanded. For a document issued from a government office it is a marvel of conciseness and intelligibility. It has admittedly been issued after consultation with leading manufacturers in the industry concerned, and as a consequence the information that is sought will be useful to a maximum degree and at the same time free from annoying trivialities. The confidential nature of the information to be disclosed is safeguarded by an undertaking that the first leaf containing the name of the firm making the return will be detached by a responsible official, so that only the anonymous statistical details will go forward to the staff of abstractors and compilers. With a view to encouraging the giving of full replies to the series of questions asked there frequently appears, in addition to the ordinary instructions, explanations as to the precise object of the enquiry and the class of information it is hoped will be elucidated. The questions cover quantity of output for the year 1907 in terms of net selling value, materials used, number of persons employed on each of four specified days at intervals of three months, days worked during the year, particulars of engine and dynamo power, and a final question to answer which is voluntary, viz., the fuel consumed in the period under review. A certain amount of latitude is allowed to firms to enable them to adjust the return to coincide with the financial year, but even so an immensity of labour is involved in the preparation of exact returns following the precise lines of the questions asked, and these it must be remembered may not tally with the form in which the accounts and records are kept. The reward for this unremunerative labour may be expected in the form of an informative and it may be hoped a promptly issued digest of the returns made, the same to be of assistance in the future development of the industry. Two further remarks may be made in conclusion, the first that the return will accurately hit off as regards the explosives industry the high water mark of cost of materials, and the low water mark of selling values. The other is that such action emphasises the increasing interest in trade questions which is being manifested no doubt as a result of the discussion of tariff policy by the leading statesmen of the day.

THE INFERIORITY OF THE BRITISH ARMY RIFLE.

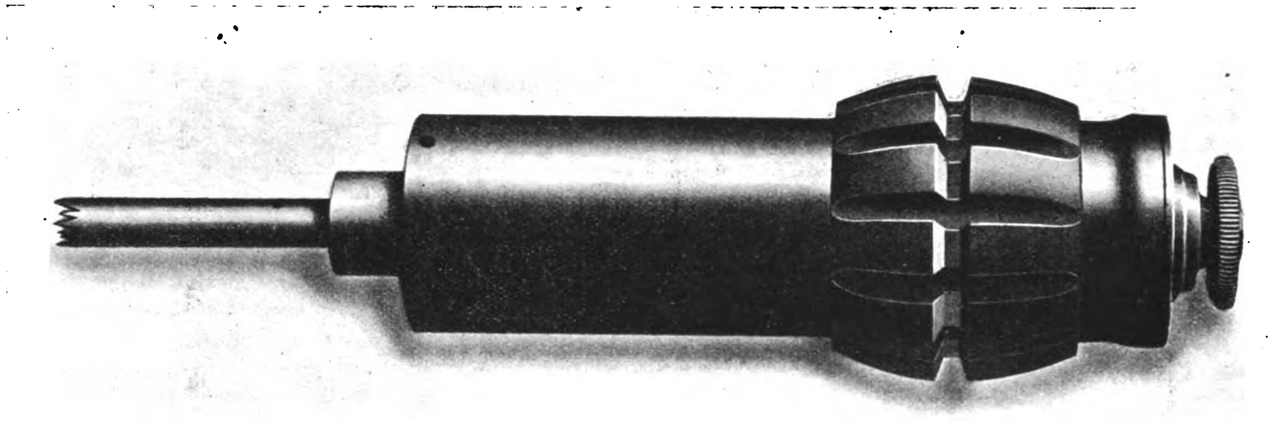
THE long article and subsequent correspondence in the *Morning Post* concerning the defects of the British army rifle have brought once more into prominence the disabilities from which the British army suffers by reason of the inferiority of the infantry weapon. It is historically inaccurate to assert that at a certain time of its existence the Lee action could compare favourably with alternative designs of breech closure. The rifle was always bad, its defects were always notorious, and it is regrettable that at the psychological moment, when sundry alterations of design were authorised, Lord Roberts, the then Commander-in-Chief threw the enormous weight of his influence into approving a rifle which was intrinsically bad. Nowadays there is no Commander-in-Chief, and, therefore, the anomaly no longer exists of one man being supposed to know everything, or at any rate having to give vital decisions on subjects needing far more study than can be possibly devoted to them by a titular chief. As a natural consequence the Committee was instructed to carry out certain fads connected with the shortening of the barrel, and the method of replenishing the magazine, but they disassociate themselves from responsibility for the bad result produced by pointing to the limited scope of their instructions. The present rifle is, therefore, bad in much the same way that Marks III., II. and I. were also bad, and the propagation of badness will doubtless continue for several more generations to come.

There is one important point on which the writers in our contemporary at first failed to make the position clear, and their failure was turned to account by Mr. Haldane in the reply given in the House of Commons. High velocity and flatness of trajectory were throughout the correspondence treated as though they might be used as interchangeable terms, and so they are with certain reservations which may be ignored in one set of circumstances, whilst under other conditions they are vital. The muzzle velocity of the German bullet is practically 3,000 f.s., but this result is achieved with a bullet weighing 139 grains, which is very light even for ·276in. calibre. That is to say 139 grains in this size of bore is equal to 2,316 grains per square inch of bore area. The Service rifle with its 215gr. bullet follows the old rule of density, viz., about 3,000 grains per square inch, the exact figure being 2,986. It is, therefore, radically unfair to compare the 2,060 f.s. muzzle velocity of the British Service rifle with the 3,000 f.s. velocity of the German Spitzer cartridge. If the bullet of the ·303 rifle were reduced to the same density level as that of the German weapon its weight would be about 168 grains. With this reduction of weight there is no reason why a velocity of about 2,600 f.s. should not be attained working within the present restrictions on pressure due to the weakness of the bolt action. Mr. Haldane's assertion that 2,600 f.s. velocity could be safely attained in the Service rifle was thus based on common sense principles, notwithstanding the incredulity which greeted his announcement. The whole question of velocity turns on the weight of the bullet in reference to the diameter of the bore, and Mr. Haldane could have confused his critics still further by assuming a brass or other low density projectile expelled from the rifle with a still higher velocity than the one he put forward. There are authorities of standing who maintain that the German bullet is unduly light, and that the trajectory, although flat enough at short ranges, is unduly rounded at the greater distances by reason of its lack of ranging power. But if the Germans so decide they can alter their bullet at a moment's notice to obtain whatever combination of short range flatness and long distance carrying power may be regarded as most beneficial. Restrictions in connection with the length of the magazine may have resulted in a specification which departs to some slight extent from the ideal. The whole point, however, of the controversy is that the Germans have a rifle which gives 3,000 f.s. to our 2,600 f.s. under one given set of comparative conditions, and one knows that this advantage will be duly reproduced whatever system of comparison is instituted so long as it proceeds on sound lines.

The difference arises from the strength of one mechanism and the feebleness of the other, and nothing but a well designed rifle to take the place of the present one will give the British army an equal efficiency per man compared with other European powers. In the secret recesses of every up-to-date engineering concern experimental models forecasting future developments are undergoing a process of slow evolution. If it costs a million of money to re-arm the military forces, the cost of an experimental model of a new rifle can be met out of petty cash. Thus if an improved design of rifle existed in the private experimental department of the Enfield rifle factory some hope might be entertained for future improvement, but this valuable commonsense procedure does not commend itself to those in power. Even when something new is required the demand comes as a surprise, and thousands of pounds are wasted on turning out unperfected models which are withdrawn in due course when the officials have begun to understand the problems involved. So far, therefore, as a new rifle is concerned the preliminary stages of enquiry and research have not been undertaken. A wave of public indignation may result in the hasty adoption of a new rifle, but the result will certainly not equal that attainable by continuously perfecting the ideal model in the recesses of the laboratory. The adoption of the extraordinary benefits arising from the use of the pointed shape of bullet has been delayed for an unreasonably long period considering that the whole of the preliminary labour was carried out in the first place in Germany, the perfected result being delivered to this country nearly three years ago. Enfield has certainly carried out three years research on the subject, but if reports are to be believed they have not discovered a single vital improvement, and the British soldier is apparently as far as ever from enjoying the advantage of a cartridge which diminishes to a marked extent the necessity for accurate range estimation. In other words Mr. Haldane's 2,600 f.s. cartridge is anxiously awaited as a first instalment of the process of modernisation which the service rifle and cartridge so urgently require.

THE HALE RIFLE GRENADE.

On Thursday the 23rd ult. a most interesting demonstration took place at the Faversham works of the Cotton Powder Co., Ld. in the presence of a distinguished company of expert diplomatic representatives. The purpose of the visit was to witness tests of Mr. Marten Hale's new shrapnel rifle grenade, a development of the hand grenade which is slung by means of an attached rope. In the present instance the soldier's rifle pure and simple becomes the throwing instrument, and it is incredible but true that a 4-oz. charge of guncotton can be projected through several hundred yards of air, and with a degree of accuracy which amply disposes of the fear that the user may be hoist with his own petard. The Cotton Powder Company are exploiting this most promising invention, and it is, therefore, through them that interested enquiriers should communicate with Mr. Hale. One reads in old records of drill sergeants being fatally shot with the ramrod carelessly left in the barrel whilst firing a blank charge, and it is this idea which forms the germ of the new contrivance for delivering high explosive charges under conditions involving high-angle fire. The practical man will almost refuse to believe that it would be possible without ring-bulging a rifle to attach to the muzzle a weight of 1½lbs., the same being projected by means of a brass rod passing some nine or more inches down the bore. Admittedly a special bulletless cartridge is used, but even so there is a matter of about 20 inches of free barrel length for the gases to rampage up and down, forming intense high-pressure waves every time the direction of flow is checked or reversed. Yet in cold, hard fact the barrel shows no sign of mistreatment after the firing of many rounds, and the projectile flies with the steady, visible motion of a rocket or line-carrying projectile. The rod acts during flight like a tail, the small surface of which, though incapable of resisting the general tendency to rock with a sinuous motion, is at the same time entirely successful in keeping the grenade with the nose foremost. Upon impact with the ground the arrestation of movement causes an internal sliding weight to drive forward, striking a percussion cap, this in turn igniting the detonator which sends off the charge of tonite situated in the body of the shell. Premature ignition is safeguarded against by locking the sliding weight by means of a split pin which is only withdrawn at the moment preceding firing. Further security during transport is provided by carrying the screw-on detonator plug separately from the rest of the shell. From the point of view of military utility there must be, and the Japanese have proved that there is, great moral advantage in being able to prepare the ground immediately in front of an infantry advance by dropping explosive charges amongst the enemy at an angle which would enable the shots to pass down a chimney if the requisite accuracy could be insured. Shallow trenches will no longer give the absolute protection from infantry attack which existed so long as flat trajectory bullets alone could be used. The grenade gives a new mode of attack, a species of compromise between rifle and artillery fire. The effects of the grenade upon impact were not of course fully demonstrated by the modest crater torn up in the earth. The explosions naturally took place above ground, the very hard baked clay earth showed a minimum of responsiveness to the penetrative capacity of the grenade and the intensity of the explosion. The real effects were spent upon the air, a self-repairing medium which fails to reproduce as on a target the marks of what have passed through it. Evidence existed in the sundry scraps of torn and disassociated shell which lay around that the neighbourhood of one of these explosions could hardly rank as a health resort. This deduction was further emphasised by the explosion of one of the grenades in a wood-lined concrete cavity, the fragments of the iron ring tearing through the wood in all directions. Even the metal rod fails to remain whole; in fact 4oz. of tonite tells its own story, and there is no need to adorn it with further verbiage. The horizontal distance traversed naturally depends on the angle at which the rifle is held. The method of firing can



either be from the shoulder, for the recoil is not excessive, or with the butt resting on the ground, a position which enables more correct aim being taken in the absence of special sighting apparatus. Generally speaking the range might be anything up to 300 yards, the distance being capable of substantial increase by using rods of greater length. The sensitiveness of the ignition apparatus is such that the fully charged grenade can be dropped point downwards from a height of about 4ft. without anything happening; at or about 6ft. the shock becomes sufficient to cause ignition. The degree of sensitiveness is, of course, adjustable to any required extent by modifying the amount of metal in the sliding weight. That the presence of one or more of the grenades on the person of the soldier is not a source of danger was somewhat dramatically proved by firing a bullet into the tonite charge of one of them when suspended across the face of a target. It tore its way through the charge, but no ignition occurred. Had the detonator been attached the result would of course, have been different but the object of the test was not to prove impossibilities, but merely the fairly obvious fact that the grenade in its ordinary portable condition is not dangerous to carry or handle. The propelling cartridges are externally the same as ordinary blank ammunition. They are charged with rifle cordite of $3\frac{3}{4}$ size, and it is understood that a de-bulletted service cartridge will satisfy the same purpose. Ball ammunition must certainly not be used, for the inevitable result would be a burst barrel at the place where the bullet strikes the obstruction. The many accidents of this nature which happen with shot guns suggest that instances of personal injury would even then be in the minority.

GUN-COTTON IN ENGLAND (1846-7).—*Concluded.*

By George W. Macdonald, M.Sc., F.C.S.

Xyloidine burnt by means of oxide of copper, with the usual precautions, gave the following results. The substance employed in the third experiment was made from arrow root.

	I.	II.	III.
Xyloidine employed ..	4·77	5·23	6·75
Carbonic acid produced	5·30	5·91	7·87
Water produced ..	1·84	1·96	2·80

Hence in 100 parts

	I.	II.	III.
Carbon	30·30	30·82	31·79
Hydrogen	4·28	4·16	4·60

In the determination of nitrogen by the differential method the proportions of the gases obtained were—

	I.	II.	III.
Carbonic acid . ..	70·7	53·4	53·8
Nitrogen	10·6	6·9	8·0

These are in the proportion of—

	I.	II.	III.
Carbon	24·0	24·0	24·0
Nitrogen	3·59	3·10	3·57

These numbers suggest the simple substitution product $C_{24}\left\{\begin{matrix}H_{17}\\3NO_4\end{matrix}\right\}O_{20}$, in which the percentage of carbon would be 31·37, and of hydrogen 3·70; yet the amount of nitrogen is somewhat too great, and there is far from being sufficient evidence to prove the definiteness of the substance itself. The wide difference also in the results obtained by various chemists can scarely be accounted for, except upon the supposition that they have operated upon very different substances.

The solubility of xyloidine in nitric acid led me to examine whether any alteration could be effected upon pyroxyline by similar means. The most dilute acid which I found to have any effect upon it in the cold was that of sp. gr. 1·414; but the alteration took place by means of this only after long standing, and but to a slight extent. Nitric acid of sp. gr. 1·45 however, is capable of dissolving pyroxyline, and alters both its composition and properties, as will be presently described; whilst fuming nitric acid has not the slightest effect upon it. The new product just mentioned is acted upon somewhat differently by various solvents, according to whether it exists in a fibrous condition, or in powder as precipitated from solution; yet I have found by experiment that no alteration in weight is effected by this change of condition. When in fibre it is slightly soluble in strong alcohol, æther, a mixture of æther with one-tenth part of alcohol, and acetic æther, but when in the pulverulent state it is very soluble in these menstrua, and in glacial acetic acid. In either condition it leaves a carbonaceous residue on combustion, is dissolved by nitric acid, whether of sp. gr. 1·25 or 1·5, and reprecipitated upon dilution. Strong sulphuric acid also dissolves it in the cold, and chars it at a temperature below 180°. These two last properties show that the original pyroxyline was perfectly free from admixture with this new substance.

There occurs a considerable decrease of weight through this transformation. In the first experiment 32 grs. of substance operated upon gave 25·82 grs. of the new product; in the second 43·64 grs. of the one yielded 34·68 of the other. Now assuming the increase in the preparation of pyroxyline to be 75 per cent., the weight of the new product above that of the original cotton would be, as calculated from these figures, 41·1 and 39·05 per cent. When this new product, whether in the fibrous or the pulverulent condition, was treated with a mixture of equal parts of nitric and sulphuric acids, it increased considerably in weight, and the resulting substance had all the properties of pyroxyline as prepared in the usual manner. 11·16 grs. of the one yielded 13·56 grs. of the other; the quantity that should theoretically have been obtained, calculating it from the decrease in making the new product, is 13·84 or 14·04 grs. Again, 12·35 grs. of the substance as precipitated from solution gave 15·75 grs., the theoretical amount would have been 15·31 or 15·54 grs. This result proves the distinctness of the new product from xyloidine, a fact that could not have been ascertained from the action of the before-mentioned solvents.

Whilst engaged in obtaining these results, I also examined the action of nitric acid of various degrees of strength upon pure cotton. By treating it with nitric acid of sp. gr. 1·5 I obtained a product evidently different from guncotton, but as it did not appear to be homogeneous throughout, I passed on to investigate the action of a weaker acid. That of sp. gr. 1·45 gave a substance which proved to identical with the product of the action of the same acid upon pyroxyline. Upon a repetition of the experiment 68·54 grs. increased in weight 14·61 grs., or 21·31 per cent.—a smaller increase than might have been anticipated, but which may easily be accounted for by the fact that the whole cotton had not been transformed, as was proved by a considerable portion being left undissolved by a boiling solution of potash. Nitric acid of sp. gr. 1·414 produced the same alteration, but only to a small extent, and after long standing. 23·75 grs. of cotton soaked in nitric acid of sp. gr. 1·516 became a hard mass, and increased in weight 13·49 grs., or 56·8 per cent.;

the action of various solvents upon the resulting substance indicated that it was a mixture of pyroxyline and the new product. On another occasion, when the transformation by means of nitric acid sp. gr. 1·47 proved to be complete, 29·52 grs. of cotton increased 9·51 grs., or 32·89 per cent. But in order to obtain a substance sufficiently pure for analysis 16·29 grs. of cotton were treated with enough nitric acid to dissolve the whole; the new product was precipitated by dilution, and the increase in weight was found to be 5·34 grs., or 32·78 per cent. In these instances there occurred a secondary product containing carbon not precipitable by water.

When this was subjected to combustion with oxide of copper the following results were obtained :—

	I.	II.	Another Specimen.
Substance employed	3·15	2·985	3·165
Carbonic acid produced	3·58	3·39	3·55
Water produced ..	1·00	1·01	1·14
Hence in 100 parts—			
Carbon 0	30·99	30·97	30·59
Hydrogen	3·52	3·75	4·00

I was unable to obtain any very accurate estimation of nitrogen by the differential method : the results most to be depended upon were—

Carbonic acid ..	120·7	76·7
Nitrogen	13·6	8·3
In the proportion of		
Carbon	24·0	24·0
Nitrogen	2·7	2·6

These numbers lead me to think that there are three equivalents of nitrogen in the compound, especially as I observed during the combustion that the substance became charred even 1 or 2 inches beyond the glowing charcoal, which will account for the deficiency of nitrogen when compared with the carbonic acid. Hence the composition of the new product coincides very nearly with that calculated from the formula $C_{24}\left\{\begin{matrix}H_{17}\\3NO_4\end{matrix}\right\}O_{20}$, namely,

Carbon	31·37
Hydrogen	3·70
Nitrogen	9·15
Oxygen	55·78
	100·00

Under this supposition the increase in weight in the preparation would be 41·66 per cent. ; very similar to that calculated from the results obtained by the action of nitric acid, sp. gr. 1·45, on pyroxyline, namely, 39·05 and 41·1 per cent. In order to add an additional proof of the identity of the two substances obtained by the action of nitric acid of sp. gr. 1·45 on cotton and on pyroxyline, and also of the fact that pyroxyline is reproduced by the action of mixed sulphuric and nitric acids upon the new product, the experiment was repeated with a portion of the substance made from pure cotton : the result was pyroxyline. In the transformation 26·56 grs. became 38·04 : now these 26·56 grs. were produced from 21·81 grs. of the original cotton ; hence the increase upon the cotton itself would be 16·23 grs., or 74·4 per cent., coinciding with the amount usually obtained in the preparation of pyroxyline.

1. From these results it appears that in the treatment of woody fibre by nitric acid raised to its highest degree of strength by the addition of sulphuric acid, 5 equivalents of the acid combine with one of lignine to produce pyroxyline displacing 5 equivalents of the elements of water, as indicated by the formula $C_{24}\left\{\begin{matrix}H_{15}\\5NO_4\end{matrix}\right\}O_{20}$. The amount per cent. of carbon and hydrogen hence deduced closely agrees also with that assigned by Mr. Ransome† and *M.* Pettenkofer.§

	Calculated.	Ransome.	Pettenkofer.
Carbon ..	26·23	26·28	26·26
Hydrogen ..	2·73	3·16	2·75

In this case the synthetical experiment would give an increase of 69·44 per cent.—nearly the amount obtained in the best experiments. My own analyses however have yielded a somewhat larger amount of carbon.

II. If lignine be treated with nitric acid combined with more than 1 equivalent of water, another compound is produced, containing a smaller proportion of the elements of nitric acid, most probably $C_{24}\left\{\begin{matrix}H_{17}\\3NO_4\end{matrix}\right\}O_{20}$, and very closely resembling, but not identical with, pyroxyline.

$$C_{24}H_{20}O_{20}+3(NO_5.\ 2HO)=C_{24}\left\{\begin{matrix}H_{17}\\3NO_4\end{matrix}\right\}O_{20}+9HO.$$

Also if pyroxyline itself be treated with nitric acid containing 3 equivalents of water, the same compound results :

$$C_{24}\left\{\begin{matrix}H_{15}\\5NO_4\end{matrix}\right\}O_{20}+2(NO_5.\ 3HO)=C_{24}\left\{\begin{matrix}H_{17}\\3NO_4\end{matrix}\right\}O_{20}+4\ (NO_5,\ HO).$$

And this transformation may be reversed.

Whilst completing my examination of this substance, my attention was drawn to the communication of *M.* Payen in the *Comptes Rendus* of Jan. 25th, where some properties of "Coton hypoazotique" are described. It is possibly the same ; yet, in order to express its distinctness from pyroxyline, I would propose as the appellation of my substance cotton-xyloidine."

(1) Memoirs of the Chem. Soc. (1846) p. 253. (2) Ibid (1847) p. 412.
**Comptes Rendus, Jan. 4. †Phil. Mag. Jan., 1847. §Pharmaceutisches Central Blatt, Dec. 30, 1846.*

GUN BARREL PROOF ACT, 1868.

The Gunmakers' Association have forwarded a copy of the following letter which they have addressed to their members :—

At a meeting of the Executive of the Gunmakers' Association, held on 8th inst., we were requested to advise you that steps were being taken for procuring the extension of the provisions of the above Act to Scotland and Ireland.

Your Executive have already approached the President of the Board of Trade upon the matter, who replied that "The Board are disposed to look favourably upon the proposal," and we understand from the Birmingham and Provincial Gunmakers' Association that a short Bill has been drawn up which the Rt. Hon. Jesse Collings is only awaiting a favourable opportunity to introduce to the House of Commons. It has consequently been suggested that the Members of the Gunmakers' Association should urge upon their local Parliamentary representative the desirability of his supporting this measure when presented, and with that object in view we enclose herewith a copy of the letter which has been addressed by the Gunmakers' Association to the several Members of Parliament representing the London constituencies. (*Signed*) H. J. Blanch, *Chairman.* F. B. Bosworth, *Secretary.*

Copy of letter referred to above.

At a meeting of the Gunmakers' Association, held on the 2nd July last, I was requested to draw your attention to the Gun Barrel Proof Act 1868, section 144 :—"Provided always that except as regards the Provisions of this Act with respect to offences by this Act declared to be misdemeanours or for which penalties are by this Act imposed and the punishment of such offences and the recovery of such Penalties this Act or anything therein shall not extend to Scotland or Ireland"

May I respectfully suggest to you that the time is now ripe for the repeal of this section and the introduction of a short Act for the purpose of extending the provisions of such Gun Barrel Proof Act to Scotland and Ireland and in the event of such an amending Act being privately introduced, to solicit your support for the same. As all reputable gunmakers and dealers in Scotland and Ireland already have their arms proved, the exemption is only made use of for the purpose of introducing American rifles and pistols without the trifling cost of proving and consequently these goods get into circulation all over England and render the owner and dealer liable to sundry penalties.

ROUND THE TRADE.

The directors of Messrs. Vickers, Sons and Maxim have declared a dividend at the rate of 12 per cent. per annum for the three months ended September 30th.

The awards at the recent Franco-British Exhibition include the firms of Eley Bros. Ld., E.C. Powder Co., Ld., and Charles Lancaster & Co., Ld., each of whom receives a diploma for Grand Prize for their exhibits of cartridges, smokeless powder and guns and rifles respectively.

A sample of the Eley ·280 cartridge has just been received at this office. It comprises the whole of the ballistic aspects of the Ross-Eley cartridge, but being made with an ordinary projecting rim suiting it for sporting rifles, as distinguished from the rimless construction for military bolt rifles, the Ross association disappears, and the cartridge joins the ranks of those available for general use. The added rim, in place of the canelure, implies a material increase of strength in the base. Consequently this cartridge would be preferred in the case of rifles not having a magazine.

Mr. Robert Gray of Messrs. Cogswell & Harrison, Ld. was called to answer a summons before the Clerkenwell magistrate to show why, on a particular occasion, he supplied a pistol to a householder without obtaining the statement signed by a magistrate or police superintendent as required by the Act. This is obviously an attempt to import a reading into the Pistols Act other than that hitherto accepted by all parties concerned. The case was heard on the 28th ult., and the magistrate reserved his decision after having expressed approval of the precautions which had been shown, by the evidence, to have been taken in accordance with the present rendering of the Act.

Messrs. Hunter and Warren, Ld. of 19 Waterloo Street, Glasgow, have issued the following circular from their offices, dated September 30th last:—"We to-day have letter from our Principals intimating an advance of 1s. per 100lbs. in price of blasting powder. They state that the cause of this advance is the greatly increased cost of saltpetre, which forms 75 per cent. of blasting powder, and the cost of which, during the last half year, has been higher than it has ever been since the Franco-German war. All makers have, therefore, advanced the price 1s. per 100lbs. which will apply to orders placed after receipt of this circular. This advance, of course, does not apply to existing contracts."

The firm of Eley have also sent a sample tube of "Maxwax," which is a composition of sundry oils and waxes constituting a pomade for the anointing of gun stocks, thereby rendering them in a high degree weatherproof. The material is suitable for including in the general paraphernalia of fittings placed inside the sportsman's gun case, and an occasional wipe over with a minute squeeze from the tube is extremely beneficial to the stock, as is proved by its resisting power when the unlucky wet day arrives. As a dressing for gun stocks which have just been buffed up to the highest state of finish it is super-excellent, because it is applied at a moment when the wood has its maximum power of absorption. The apparent result is no better than with ordinary dressings and decidedly inferior to the shine which is produced by a single wipe from the bottle of shellac varnish. The material takes its stand strictly on the grounds of its lasting properties. Too many guns are at the present time sent out with stocks of beautiful finish and figure all of which goes with the first rain shower. Maxwax corrects this deficiency, the condition of the stock improving with every year of use, provided that the shooter continues the treatment with one or two dressings per annum. The same properties admirably fit the material as a combined preservative and dressing for leather gun cases, cartridge magazines and kit bags generally.

Messrs. Eley Bros. have obtained the exclusive rights in connection with the "Lethal" bullet, which is a spherical ball for smooth-bore guns weighing 1⅛oz. It is specially noticeable on account of a series of three equator-like ribs which increase the diameter of the bullet from its normal ·693 inch to a maximum of about ·730in. The small resistance offered by these ribs enables the ball to be used in choke and cylinder guns indiscriminately, the ribs giving a steady bearing in the large part of the barrel, without interfering with the capacity of the bullet to pass through the choke without encountering serious resistance. The bullet is also characterised by being moulded around a pair of metal discs, the object of which is to restrict the cohesion of the bullet; thereby promoting expansion on impact.

The London Small Arms Co., Ld. have written pointing out that in noticing their aperture sight for the converted Martini rifle it was erroneously stated that the front screw fastened into the rear part of the metal shoe where it adjoins the grip. In point of fact this is not so, since both screws are fastened into the upper side of the wood grip. When a sight of this kind is bedded on the grip of the stock it must naturally be placed either very far forward, or else well back, so as to be clear of the space for the shooter's thumb. The L.S.A. sight is specially adapted for the far back position which brings it close up to the shooter's eye, at the same time occupying a position where the distance from the fastening base to the line of sight is sufficient to accommodate a convenient length of stem.

The claim which was made by the Inland Revenue department that occupiers of tents in the bazaar lines at Bisley should take out hawkers' licences resulted in various summonses being issued. These have now been withdrawn as an act of grace, but the Board of Inland Revenue maintain in the following statement to the firms involved the justice of their claim and the intention to enforce it in the future:—"The board direct me to acquaint you that they have had the above matter again under review, and that, while in no way receding from their opinion that liability to duty has been incurred, they have decided not to take action for the recovery of the duty so far as this year is concerned, having regard to the somewhat exceptional circumstances of the case. The matter will be considered again next year, and the board's present decision is without prejudice to any action which may be deemed necessary then."

The annual report and balance sheet of the Birmingham Small Arms Co., Ld., shows a profit of £98,837, which with the amount brought forward from last year, gives £110,094 available for distribution. The interim dividends absorbed £30,836 and the further distribution, which was authorised at the annual general meeting, raises the total dividend to five per cent. on the preference shares and ten per cent. on the ordinary, with an added bonus of five shillings per share. This leaves a balance of £22,860 to carry forward. Sir Hallewell Rogers, in his speech at the general meeting, after referring to the general position of the company, especially with regard to the cycle trade, said that the Government orders for the new short rifle had been smaller, and the contract prices lower, than those of the preceding year, but this was a department that must necessarily fluctuate from time to time. They were now engaged upon a large number of conversions of the older pattern rifles required for the Territorial army, and considerable orders had also been obtained for cadet rifles. There was an increasing demand, too, for air and miniature rifles, and they hoped to be able to produce at an early date a miniature rifle suitable for club work and rook shooting at a price which could compete with any American or Continental rifle on the market. Although the outlook as regards Government orders for service rifles was not very promising, this department would be fully occupied on present orders until the close of the Government financial year in March.

THE ROSS RIFLE AT BISLEY.

THE many friends of Mr. F. W. Jones will sympathise most sincerely with him in the unfortunate sequel to his brilliant successes with the match rifle at the recent Bisley Meeting. The National Rifle Association have a rule that the weight of the barrel in a match rifle shall not exceed 3¼lbs. In the case of rifles of unusual type or pattern there is nothing but the word of the maker to protect the shooter from the humiliating consequences which necessarily follow if an error happens to be made. The barrels of the consignment of Ross rifles which reached England just in time for the Bisley Meeting were half-a-pound overweight, and everyone who used them has suffered the penalty of self-disqualification. The rule as to the weight of barrel was well understood in the Ross factory, and the earlier weapons were turned out with the barrels correctly adjusted to the required standard. This operation appears to have been omitted in the subsequent consignment, and Mr. Jones ranks as the chief offender, inasmuch as he was the chief prize winner and the one who, by good shooting, brought the merits of the Ross-Eley ·280 cartridge into public prominence.

The error was first suspected when shooters noticed the apparently considerable excess dimensions of the Ross barrel as compared with that of other rifles whose weight of barrel was known. The point could not be tested on the spot, because the removal of a barrel from the action is a task not lightly undertaken. Moreover the adjustment, of the sights is disturbed, and there is always the possibility that a barrel may not remain firmly seated after the second fixing. The matter came in due course to the notice of the Council of the National Rifle Association, who decided on the last day of the meeting that no action could be taken after the completion of the competitions involved. One of the rifles was in their possession for an entire day, yet no one knew whether or not the rule had been infringed. Matters remained in this unsatisfactory state for several weeks, but the difficulty was finally overcome when Mr. Jones caused his barrel to be dismounted and weighed. Finding it half-a-pound on the heavy side he returned his prize money to the Association. Others followed suit in due course, and the National Rifle Association had nothing to do at their last meeting but to accept the money and announce that a revised prize list would be issued in due course.

From a rifle shooting point of view it is extremely difficult to lay down what would have been the precise effect on the scores made had the barrel been of the correct weight. The margin of difference between the best and the second best score in a competition is so exceedingly minute that no one can say exactly what constitutes the boundary. The Ross cartridge undoubtedly possesses characteristics which render it in a high degree suitable for match rifle shooting. These characteristics were deliberately incorporated into its design, largely as a result of Mr. Jones's calculations and experiments at the long ranges. That he attained a substantial measure of success is attested by the performances of the original rifle, the barrel of which was true to weight. At the meeting of the English VIII. club Mr. Jones won first place in the aggregate of two days' shooting, Colonel Hopton having previously won this prize for something like seven consecutive years. On the other hand the N.R.A. rule does not affect all rifles alike, and it especially penalises a weapon like the Ross rifle, which is designed with a very light body and stock, the necessary total weight being made up in the barrel. The service ·303 rifle on the other hand is heavy in the action and light in the barrel, viz., 3lbs. The allowed surplus of four ounces for match rifles still leaves a barrel unduly light for the firing of the powerful cartridges which are commonly used in match rifle competitions. For the purpose of recoil absorption the weight should as far as possible be disposed in the line of the barrel, and, therefore, all available metal should be concentrated in the barrel. In the Ross rifle the total weight of the weapon is small unless the barrel is fairly heavily weighted. A weighty barrel certainly assists in stabilising the sighting of the rifle. The zero then remains constant, so avoiding the puzzling inconsistencies which are attributed to a "floating" zero.

There is, of course, no doubt that the N.R.A. introduced their barrel rule in preference to restricting the over-all weight of the rifle in the hope of preventing undue divergencies from a strictly military type of arm. Subsequent events have shown that the opposite effect to the one intended has supervened. It is, moreover, bad to restrict design by specifying a maximum weight of barrel. The practical question is the amount of weight the soldier must carry, and the mass necessary to take up the recoil due to discharge. The greatest possible proportion of the total weight should certainly be represented by the barrel, but even so it is questionable whether the match rifle shot might not reasonably be allowed a pound or two surplus of weight over the military arm. The shooting test to which he submits his cartridges is far more delicate than anything the soldier would require to imitate. Moreover, he places the backsight on the rear end of the butt, and, therefore, depends to a much greater extent than the soldier on a stable fastening between wood and metal. A heavily weighted barrel diminishes the thrust against the wood, and thereby minimises the difficulties incidental to the peculiar nature of the sights. Rules like many other human contrivances appear to be perfect until they are put to the practical test. For match rifle work it seems as though the rules governing the rifle should be reduced to the simplest possible footing, the restrictions to be mainly confined to the cartridge. The Ross rifle and cartridge have at any rate received a magnificent advertisement, and next year's results will be watched with special interest.

AMASITE LD., is the name of a company which has been registered with a capital of £25,000 to acquire from W. Rickmers and B. E. D. Kilburn the benefit of certain inventions relating to the manufacture of explosives, etc. The first directors are Mr. C. M. Chapman, Major D. P. Chapman and Mr. G. Perrin.

LECTURES TO YOUNG GUNMAKERS.

LIV.—LOADING DETAILS FOR THIN BRASS CARTRIDGES.

LAST month's lecture dealt with some of the preliminary details connected with the loading of thin brass cartridges. The plan adopted was to review the entire series of cartridges in order to reduce them to a kind of common denominator, whereby experimental data regarding one cartridge could be applied to another. The resulting maximum of information is valuable in a direction where practical experience is necessarily restricted by the very small vogue these cartridges enjoy. The common denominator which all sporting cartridges share alike is length, and if the various components of the load occupy a given length in the cartridge substantial similarity of result will follow. But before equality of length can be established a vast amount of preliminary measuring is necessary, and hitherto no one has regarded the matter as of sufficient interest to justify the mass of tedious detail work which is involved.

Last month's preliminary instalment of information comprised the length of column of a long series of powder charges in the various bores associated with thin brass cases. The powder was measured in an uncompressed state, being, therefore, in the condition in which it passes from the loading machine into the cartridge case. The measurements in question were purposely given in this incomplete form in order that a further process of checking might be applied to them previous to making the necessary modifications of length to cover the subsequent loading processes. One defect was, for instance, immediately apparent when last month's tables were subjected to this process of revision. Concerning the space occupied by 42-grain powders in 8-bores and 10-bores it is obvious that a given quantity of powder should occupy less length in the larger cartridge than in the smaller one. The table dealt with 17 charges advancing in grain stages, yet it gave an identical rise in the height of the powder column for both these bores in respect to 42-grain powders. The 33-grain table showed the expected difference for the two sizes of cartridge. When the cause came to be investigated it was found that the variations involved were so slight that a very small error in the curves might produce an anomalous result, especially in connection with measurements which are taken on such a relatively coarse scale as the hundredth part of an inch. However, the substantial accuracy of the published figures was not allowed to stand in the way of giving them a thorough overhaul. As a result new tests of accuracy were devised, and a number of small changes were in due course made. The values for length of powder column were then converted into the form found most useful for directing loading operations, viz., by subjecting them to a uniform addition throughout of ·05 of an inch. This figure was arrived at by adding ·17 for the two twelfth-inch cards on either side of the felt, and deducting ·12 for the compression applied to the powder. The tabulated powder measurements are thus on the average ·05 more than the corresponding figures in the last lecture, the variations from the average being due to the smoothing processes already alluded to. The full results, to be presented later on, have been analysed in the following table :—

TABLE I.—*Difference Test of Values adopted for the space occupied by the powder charge in Thin Brass Cartridges.*

Bore.	Relative Area.	Difference.	42-GRAIN POWDERS. Difference for 16 grs.	Second Difference	33-GRAIN POWDERS. Difference for 16 grs.	Second Difference
			in.		in.	
8	783		·23		·29	
		111		4		6
10	672		·27		·35	
		71		2		2
12	601		·29		·37	
		53		3		4
14	548		·32		·41	
		47		3		4
16	501		·35		·45	
		63		4		4
20	438		·39		·49	
		46		6		8
24	392		·45		·57	
		54		6		6
28	338		·51		·63	
		47		7		10
32	291		·58		·73	

The column of relative areas shows that the popular bores represent a fairly uniform series of graduations when the 14-bore is included ; otherwise the last named constitutes an exception. The figures expressing area have no special meaning except in a comparative sense. In point of fact they were arrived at by taking the first three figures of the square of the bore, area being of course proportional to the square of the diameter. The relative area of the several bores of cartridge is similarly expressed by comparing the length of column occupied by a given quantity of powder. Taking the column of differences of relative area as expressing a general comparison between the adjoining sizes of cartridge, the powder differences should harmonise therewith to a reasonable extent. This last qualification is necessary, as may be indicated by pointing out that although the values for the 42-grain and 33-grain powders are taken from absolutely the same curves the second differences are by no means in harmony. This arises from applying an extremely delicate test to relatively coarse measurements. Therefore, allowing that the two sets of powder differences are derived from absolutely the same curves, it will be understood that their lack of perfect concordance one with the other justifies the taking of an equally broad view when comparing them with the column of relative areas. The main figures are in proper series, and the minuter discrepancies shown in the difference columns must be ascribed to manufacturing variations in the specimen cartridges which were employed in the measuring tests. These would naturally vary both as regards the thickness of the base and the diameter of the cartridge tube.

The process of measurement for determining the space occupied by the various shot charges may next be described. The specimen cartridge cases were filled with wadding at the base so as to leave the usual flat surface for the shot charge to rest upon. Weighed charges of No. 6 shot were

inserted in succession into each cartridge, and the height of the column was carefully measured. When the various values were compared with one another it was invariably found that the first ounce occupied more space than the second ounce. The persistency of this occurrence drew attention to its obvious explanation, viz., that space is wasted at the top and bottom of a shot charge where it adjoins the card wads; thus, for instance, two ounces occupies rather less than twice the space of one ounce. All the sizes except 8-bore showed a uniform difference of ·02in. between the first measurement and the second. A careful re-test confirmed all previous observations, so that the following series of carefully checked measurements were adopted as the basis of the shot table :—

TABLE II.—*Measurements of Weighed Quantities of Shot in Thin Brass Cartridges*

Bore.	Weighed Charges as inserted.	Measurements of same.	Difference between first and subsequent measurements.
	oz.	in.	
8	0–1	·48	·04
	1–2	·44	
10	0–1	·54	·02
	1–2	·52	
12	0–1	·58	·02
	1–2	·56	
14	0–1	·64	·02
	1–2	·62	
16	0–1	·74	·02
	1–2	·72	
20	0–½	·41	·02
	½–1	·39	
	1–1½	·39	
24	0–½	·48	·02
	½–1	·46	
	1–1½	·46	
28	0–½	·52	·02
	½–1	·50	
	1–1½	·50	
32	0–½	·62	·02
	½–1	·60	

The process of building up a complete table of measurements of shot charges advancing in sixteenth-ounce stages is extremely simple. A series of probable charges is selected for each bore, and the equivalent on the first on the list is set down. Thus if one required to start the 16-bore table with ¾-oz., it would be obvious that if one ounce measures ·74in. and the next ounce ·72, then ¾oz. would equal ·74 minus a quarter of ·72, viz., ·56. Though the arithmetical processes are throughout very simple, great care had obviously to be taken to prevent the inclusion of errors in the final results, and sundry checks and cross comparisons had necessarily to be made at the various stages. Just as in the case of the powder tables where it is convenient to provide for the card wads and the compression of the charge, so in the matter of the shot it is necessary to allow for the top wad and the turnover, or " crimp " as it is termed in the case of brass cartridges. The $\frac{1}{16}$in. thickness of top wad holds good for the loading of thin brass cartridges just as much as paper, though in regard to the crimp, whilst the measurements which are suitable for paper are also suitable for brass, much greater variations may be tolerated in the latter instance without interfering with the efficiency of the loading. Whilst, therefore, a thin brass case may indifferently possess a deep or a shallow turnover the table deals only with the happy medium. Thus the lengths of shot column, which are introduced in sandwich form between the powder measurements, represent the depth from the mouth of the case to the overfelt wad, thus including the space occupied by the shot and the top wad, and also the allowance that must be made for the crimp.

Experience gained in the working of the tables published in connection with paper cartridges has shown that reference is facilitated by bringing the values which have to be taken into account in close juxtaposition with one another. The plan adopted in the present tables is, therefore, to show the whole of the particulars for each bore in adjoining columns, the shot measurements being flanked on either side by those relating to 42-grain and 33-grain powders respectively. The eye can pass from one powder column to the other with great rapidity, thus bringing into prominence the equivalent bulks of any two powders.

TABLE III.—*Height of Powder (compressed ·12 in.) from base of cartridge plus two twelfth-inch cards also, as regards shot, distance to allow from mouth of case to over-felt wad.*

8

42 Grain Powder.		Shot (turnover ·85 in.)		33 Grain Powder.	
Grs.	In.	Oz.	In.	Grs.	In.
74	1·26	1½	1·11	58	1·26
75	1·27	1⅝	1·17	59	1·27
76	1·29	1¾	1·22	60	1·29
77	1·30	1⅞	1·28	61	1·31
78	1·32	2	1·33	62	1·33
79	1·33	2⅛	1·39	63	1·35
80	1·35	2¼	1·44	64	1·37
81	1·36	2⅜	1·50	65	1·39
82	1·38	2½	1·55	66	1·40
83	1·39	2⅝	1·61	67	1·42
84	1·40	2¾	1·66	68	1·44
85	1·42	2⅞	1·72	69	1·46
86	1·43	3	1·77	70	1·48
87	1·45			71	1·50
88	1·46			72	1·51
89	1·48			73	1·53
90	1·49			74	1·55

10

42 Grain Powder.		Shot (·82 in.)		33 Grain Powder.	
Grs.	In.	Oz.	In.	Grs.	In.
48	1·00	1¼	1·05	36	·96
49	1·02	1 5/16	1·08	37	·99
50	1·04	1⅜	1·12	38	1·01
51	1·05	1 7/16	1·15	39	1·03
52	1·07	1½	1·18	40	1·05
53	1·09	1 9/16	1·21	41	1·07
54	1·10	1⅝	1·25	42	1·10
55	1·12	1 11/16	1·28	43	1·12
56	1·14	1¾	1·31	44	1·14
57	1·15	1 13/16	1·34	45	1·16
58	1·17	1⅞	1·38	46	1·18
59	1·19	1 15/16	1·41	47	1·20
60	1·20	2	1·44	48	1·22
61	1·22			49	1·25
62	1·24			50	1·27
63	1·25			51	1·29
64	1·27			52	1·31

12

42 Grain Powder.		Shot (·80 in.)		33 Grain Powder.	
Grs.	In.	Oz.	In.	Grs.	In.
44	1·03	1	·94	32	·97
45	1·05	1 1/16	·98	33	·99
46	1·07	1⅛	1·01	34	1·01
47	1·09	1 3/16	1·05	35	1·04
48	1·10	1¼	1·08	36	1·06
49	1·12	1 5/16	1·12	37	1·09
50	1·14	1⅜	1·15	38	1·11
51	1·16	1 7/16	1·19	39	1·13
52	1·18	1½	1·22	40	1·16
53	1·20	1 9/16	1·26	41	1·18
54	1·21	1⅝	1·29	42	1·20
55	1·23	1 11/16	1·33	43	1·23
56	1·25	1¾	1·35	44	1·25
57	1·27			45	1·27
58	1·29			46	1·30
59	1·30			47	1·32
60	1·32			48	1·34

14

42 Grain Powder.		Shot (·29 in.)		33 Grain Powder.	
Grs	In.	Oz.	In.	Grs.	In.
40	1·06	7/8	·91	30	1·02
41	1·08	15/16	·95	31	1·05
42	1·10	1	·99	32	1·07
43	1·12	1 1/16	1·03	33	1·10
44	1·14	1⅛	1·07	34	1·13
45	1·16	1 3/16	1·11	35	1·15
46	1·18	1¼	1·15	36	1·18
47	1·20	1 5/16	1·19	37	1·20
48	1·22	1⅜	1·23	38	1·23
49	1·24	1 7/16	1·27	39	1·25
50	1·26	1½	1·30	40	1·28
51	1·28	1 9/16	1·34	41	1·30
52	1·30	1⅝	1·38	42	1·33
53	1·32			43	1·36
54	1·34			44	1·38
55	1·36			45	1·41
56	1·38			46	1·43

16

42 Grain Powder		Shot (·28 in.)		33 Grain Powder.	
Grs.	In.	Oz.	In.	Grs.	In.
37	1·07	¾	·90	27	1·01
38	1·09	13/16	·95	28	1·04
39	1·11	⅞	·99	29	1·07
40	1·14	15/16	1·04	30	1·10
41	1·16	1	1·08	31	1·13
42	1·18	1 1/16	1·13	32	1·16
43	1·20	1⅛	1·17	33	1·18
44	1·22	1 3/16	1·22	34	1·21
45	1·24	1¼	1·26	35	1·24
46	1·27	1 5/16	1·31	36	1·27
47	1·29	1⅜	1·35	37	1·30
48	1·31	1 7/16	1·40	38	1·32
49	1·33	1½	1·44	39	1·35
50	1·35			40	1·38
51	1·38			41	1·41
52	1·40			42	1·44
53	1·42			43	1·46

20

42 Grain Powder.		Shot (·25 in.)		33 Grain Powder.	
Grs.	In.	Oz.	In.	Grs.	In.
31	1·03	⅝	·92	24	1·03
32	1·05	11/16	·97	25	1·06
33	1·08	¾	1·01	26	1·09
34	1·10	13/16	1·06	27	1·12
35	1·13	⅞	1·11	28	1·15
36	1·16	15/16	1·16	29	1·18
37	1·18	1	1·21	30	1·21
38	1·20	1 1/16	1·26	31	1·24
39	1·22	1⅛	1·31	32	1·27
40	1·25	1 3/16	1·36	33	1·30
41	1·28	1¼	1·40	34	1·33
42	1·30	1 5/16	1·45	35	1·36
43	1·32	1⅜	1·50	36	1·39
44	1·35			37	1·42
45	1·37			38	1·46
46	1·40			39	1·49
47	1·42			40	1·52

24

42 Grain Powder.		Shot (·22 in.)		33 Grain Powder.	
Grs.	In.	Oz.	In.	Grs.	In.
24	·96	½	·76	17	·89
25	·98	9/16	·82	18	·93
26	1·01	⅝	·88	19	·96
27	1·04	11/16	·93	20	1·00
28	1·07	¾	·99	21	1·03
29	1·10	13/16	1·05	22	1·07
30	1·12	⅞	1·11	23	1·11
31	1·15	15/16	1·16	24	1·14
32	1·18	1	1·22	25	1·18
33	1·21	1 1/16	1·28	26	1·21
34	1·24	1⅛	1·34	27	1·25
35	1·26	1 3/16	1·39	28	1·28
36	1·29	1¼	1·45	29	1·32
37	1·32			30	1·36
38	1·35			31	1·39
39	1·38			32	1·43
40	1·41			33	1·46

28

42 Grain Powder		Shot (·20 in.)		33 Grain Powder.	
Grs.	In.	Oz.	In.	Grs.	In.
17	·84	⅝	·66	12	·80
18	·87	11/16	·72	13	·84
19	·90	¾	·78	14	·87
20	·93	13/16	·84	15	·91
21	·96	⅞	·91	16	·95
22	1·00	15/16	·97	17	·99
23	1·03	1	1·03	18	1·03
24	1·06	1 1/16	1·09	19	1·07
25	1·09	1⅛	1·16	20	1·11
26	1·12	1 3/16	1·22	21	1·15
27	1·16	1¼	1·28	22	1·19
28	1·19	1 5/16	1·34	23	1·23
29	1·22	1⅜	1·41	24	1·27
30	1·25			25	1·31
31	1·28			26	1·35
32	1·31			27	1·39
33	1·35			28	1·43

32

42 Grain Powder.		Shot (·18 in.)		33 Grain Powder.	
Grs.	In.	Oz.	In.	Grs.	In.
12	·77	¼	·56	10	·80
13	·80	5/16	·64	11	·84
14	·84	⅜	·71	12	·89
15	·88	7/16	·79	13	·93
16	·91	½	·86	14	·98
17	·95	9/16	·94	15	1·03
18	·98	⅝	1·01	16	1·07
19	1·02	11/16	1·09	17	1·12
20	1·06	¾	1·16	18	1·16
21	1·09	13/16	1·24	19	1·21
22	1·13	⅞	1·31	20	1·25
23	1·17	15/16	1·39	21	1·30
24	1·20	1	1·46	22	1·35
25	1·24			23	1·40
26	1·27			24	1·44
27	1·31			25	1·49
28	1·35			26	1·53

MEMOS.

Take ⅜-inch felt = ·37in.
,, 7/16 ,, ,, = ·43in.
,, ½ ,, ,, = ·50in.

The ·410 thin brass is not specified, the load being 12 or 10grs. according to the class of powder used and ⅝oz. shot, using three thin cards and a ¼in. felt.

Another lecture must be devoted to dealing at length with the conclusions which can be drawn from the material now tabulated. Meantime it may be explained at once that the mode of operation is exceedingly simple. Thus if the problem is to employ a charge in the region of, say, 52 grains of Schultze or Amberite in a 12-bore thin brass cartridge in combination with 1½oz. of shot, the table at once shows that the components will occupy a space of 2·40in. As this measurement does not include the felt wad it will at once be apparent that the ordinary nominal 2½in. case would not leave the necessary surplus of length to accommodate a ⅜in. (·37) felt wad. It is equally apparent that a 2¾in. (2·75in.) length of case with very slight adjustment of compression or depth of turnover would satisfy the required conditions; and further that if a 3-inch case were to be used there would be a quarter-inch of unnecessary length to be filled with wadding or left as surplus turnover, according to the taste of the loader. In fact the working of the tables when once compiled represents an operation as simple in the carrying out as the original compilation has been tedious and difficult. In other words the work having once been thoroughly done it immensely lessens the labours of the loader who may be called upon at any hour of the day to load to the best advantage some subtle combination demanded by one of the firm's customers. Though the vogue of thin brass cartridges is, as has already been mentioned, extremely limited, it must nevertheless be understood that when orders do come they should receive proper attention, and the accompanying tables ought to be of great assistance in analysing suggested loads, or conversely in devising suitable combinations when no restrictions have been laid down.

APPLICATIONS FOR PATENTS.

SEPTEMBER 21—OCTOBER 17, 1908.

19,901. Ordnance Training Gear. A. T. Dawson and G. T. Buckham.
19,926. Elevating and Loading Gear of Howitzers. A. T. Dawson and G. T. Buckham.
19,940. Projectiles. M. Peluso.
20,042. Magazine Rifle Clips. M. G. Farquhar.
20,130. Rifle Foresights. W. E. Henry.
20,214.* Explosives. W. H. Palmer.
20,229. Disappearing Targets. H. Phillips.
20,238. Rifle Butt. G. Clarke.
20,261.* Protective Shields for Ordance. Fried Krupp.
20,279.* Explosives. F. W. Bawden.
20,315.* Optical Squares for Range Finders. H. D. Taylor.
20,372.* Automatic Firearms. J. J. Reifgraber.
20,442. Air-Rifle Target. H. H. Pratt.
20,507. Single-Trigger Mechanism. J. W. Smallman.
20,568.* Small Arms. P. Mauser.
20,574.* Blasting Powder. H. D. Farris and A. C. Jex.
20,738. Gun Wadding. R. W. Glanville.
20,795. Indicating Range of Fire. J. A. Seddon.
20,804.* Guns Firing at High Elevations. J. A. Deport.
20,855. Eye Protector for Gun Sighting Telescopes. C. R. C. Hart.
20,872. Protective Shield for Firearms. J. Singer.
20,981.* Recoiling Barrel Guns. E. Olsson.
21,015. Ordnance Sighting Gear. F. Wigley and F. Duncan.
21,030. Lever-bolt Action. P. T. Clift and A. E. Morton.
21,038. Registering Bullseyes. H. T. Dumbleton.
21,126. Checking Target Scores. R. W. Glanville.
21,189. Loading-Arm. P. Buhl.
21,248.* Percussion Fuses. Fried Krupp.
21,257.* Automatic Targets. C. W. Plaice.

21,262.* Field Guns. Rhienische Metallwaren und Maschinenfabrik.
21,358. Rifle Sight Bar. G. F. Rose.
21,472.* Gun Sighting Apparatus. La Société Schneider et Cie.
21,475. Projectiles. S. O. Cowper-Coles.
21,516. Rifle Sights. H. Greener.
21,922. Firing Gear of Ordnance. A. T. Dawson and G. T. Buckham.
21,930. Cartridge Extracting Mechanism for Ordnance. A. T. Dawson and G. T. Buckham.
21,978. Rifle Backsight. J. Beveridge.
22,007. Projectiles. A. G. Hudson.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

SEPTEMBER 24—OCTOBER 15, 1908.

COMPILED BY HENRY TARRANT.

12,373 (1907). **Projectile Construction.** W. E. Lake, London (Agent for *A., R., and S. Cabello, née Dell 'Oro, Italy*). A cup-shaped recess is provided in the front of the projectile for punching a hole when it strikes an armour plate. The recess is covered with a metal cap of ordinary nose-shape and is filled with a lubricant to facilitate the punching operation. A striker running to the base of the projectile is situated in the bottom of the cup so that when the core of armour plate enters the cup the explosive charge is ignited. Accepted August 28, 1908.

16,080 (1907). **Projectile Construction.** T. Tucker, U.S.A. A projectile of peculiar formation is adapted to penetrate water when it strikes, instead of ricocheting as is usual. It will maintain the direction of its flight beneath the water. It is cylindrical in shape and has a longitudinal central passage provided with lateral openings. Its head has spirally set prongs and its tail spiral " flukes " fitting in a tail block. Accepted Sept. 10, 1908.

19,104 (1907). **Armour Piercing Projectile Caps.** R. A. Hadfield, Sheffield. The construction of metal caps for projectiles is improved so that not only is the efficiency in armour piercing increased but the flight of the projectile is improved. A portion of a twelve-inch projectile is illustrated in the specification and the dimensions are fully set out of the obtuse angled front end portion which is connected to the body by an intermediate part having an ogival surface. Accepted Sept. 24, 1908.

19,941 (1907). **Bolt Action Rifle Construction.** The Birmingham Small Arms Co., Ld., A. H. M. Driver and G. Norman. (*See Selected Patents*).

20,578 (1907). **Magazine Air Rifles.** H. A. C. Schobert, London. A repeating air gun of the spring plunger type in which a horizontally moving slide during one complete rearward and forward stroke, compresses the plunger spring, engages the plunger with the sear of the trigger mechanism, operates a safety lock, brings into action the magazine parts and operates the breech block to receive a pellet from the magazine. The horizontally moving slide is reciprocated by a pivoted lever normally lying beneath the barrel. Accepted Sept. 16, 1908.

20,719 (1907). **Sporting Gun Breech Mechanism.** Charles Ryland, Birmingham. A new method of connecting the " holding down bolt " with the top lever of an ordinary break down pattern sporting gun is described in this patent.. Accepted Sept. 10, 1908.

21,926 (1907). **Back Sight Slide for Rifles.** The Birmingham Small Arms Co., A. H. M. Driver and G. Norman, Birmingham. Screw adjustment is provided for the Government pattern wind-gauge slide for rifle back sights. The screw is left-hand threaded half its length and the reverse the other half, and the slide and bar are threaded accordingly. This arrangement creates a pulling and pushing movement when the screw is turned, so that the slide moves at double the speed of the screw. Accepted Sept. 10, 1908.

24,123 (1907). **Construction of Ordnance Breech Mechanism.** S. A. S. Hamman, U.S.A. The breech block and screw box of ordnance described in this patent are each provided with eccentric helical threads and each of the threads is formed in a series of steps of progressively greater radii. These threads or collars have inclined thrust surfaces, blank spaces being adjacent to the lowest of the steps. Many advantages are claimed. Accepted Sept. 17, 1908.

24,272 (1907). **Service Rifle Sights.** H. T. Ashton and J. J. Speed, Enfield Lock. To the rear of the back sight of the British Service pattern short Lee-Enfield rifle is hinged a plate carrying an aperture for " peep " sighting. This plate may be turned up so that the aperture occupies a position exactly corresponding with the existant open sighting notch. It is spring controlled so that it may be held firmly in either of its two positions. Accepted Sept. 3, 1908.

26,546 (1907). **Range Finders.** Dr. O. Eppenstein, Germany. In order to secure a telemeter against derangement through the displacement of a hinder objective part, each system of measuring marks is placed on an objective lens or else on the objective prism, if the latter forms the hinder objective part, and in a field lying at right angles to the axis of the lens. Accepted Sept. 10, 1908.

26,943 (1907). **Aperture Sights for Rifles.** The Birmingham Small Arms Co., Ld., A. H. M. Driver, and G. Norman. (*See Selected Patents*).

2,097 (1908). **Cartridge Caps Anvils.** E. Jones and Kynoch, Ld., Birmingham. The anvils described in this patent consist of wire bent into the form of a loop or staple, the ends of the wire being bent so as to form a circular base. Accepted Sept. 10, 1908.

2,480 (1908). **Elevating Gear for Ordnance.** Fried. Krupp, A.-G., Germany. In electrically driven elevating gear the number of revolutions of the electro-motor which moves the gun barrel is automatically regulated so that the movement of the barrel takes place more slowly in the vicinity of the loading position as well as in the last portion of the passage over into the adjusted elevation than it does outside these limits. Specially accurate adjustment is claimed to be guaranteed by this arrangement. Accepted Sept. 24, 1908.

3,634 (1908). **Elevating Gear for Ordnance.** Fried. Krupp, A.-G., Germany. In electrically driven elevating gear the armature circuit of an electro-motor for transferring the gun into the loading and firing positions is closed on the movement of the gun barrel which follows the shot and by the closing of the breech mechanism. Automatic transference from firing to loading position and *vice versa* is thus secured. Accepted Sept. 24, 1908.

6,358 (1908). **Firing Rifles at Predetermined Elevations.** Major A. Müller, Germany. In German patents Nos. 179,443 and 181,705, apparatus for bringing about the automatic discharge of a rifle when elevated to a predetermined angle is described. This mechanism which is carried in the stock is improved upon. Accepted Sept. 3, 1908.

7,809 (1908). **Percussion Fuses for Projectiles.** E. Schneider, France. This patent deals with the kind of fuse in which a cock is adapted to be rotated either to place a column of quick burning powder in communication with the bursting charge, to cut this off and open up a slow burning column, or to cause the striker to be held so that the priming cannot be fired. A spring bolt is now introduced to engage with one or other of the recesses in the cock mentioned. Accepted Sept. 3, 1908.

7,881 (1908). **Ejector Mechanism for Single Barrelled Guns.** C. Ryland, Birmingham. Ribs arranged on the side of the action body are responsible when the gun is broken down for disengaging a sear which holds the spring " kicked " cartridge ejector. The closing of the gun compresses the spring and allows the sear again to enter the bent. Accepted Sept. 3, 1908.

9,448 (1908). **Fuse-Setting Machine.** Fried. Krupp, A.-G., Germany. In apparatus for correcting the principal adjustment in that type of fuse setter in which the principal adjustment and its correction are made by rotating

one and the same setting body the gearing designed for making the corrections can be brought into positive connection with the setting body employed for the adjustment of the machine so that the two operations which had to be performed in succession can be done simultaneously. Accepted Sept. 24, 1908.

9,521 (1908). **Safety Device for Projectile Fuses.** E. Schneider, France. Hitherto a pin had to be withdrawn or sheared from the striker of a fuse to unlock it before being placed in the gun. The patentee does away with this and introduces spring bolts or flexible hooks adapted to engage the striker and to be released by the action of the fuse setting device. Accepted Sept. 17, 1908.

9,734 (1908). **Barrel Recoil Ordnance.** Fried. Krupp, A.-G., Germany. Barrel carriages for travelling barrel recoil ordnance are improved. In known carriages the rear wheels have to be raised off the ground for unloading or loading the gun barrel. The patentee overcomes this difficulty by movably connecting the perch of the barrel carriage with the wheel axle of the rear carriage so that it can be rocked about an axis which falls at least approximately in the longitudinal direction of the rear carriage. Accepted Sept. 10, 1908.

11,108 (1908). **Travelling Ordnance with Barrel Recoil.** Fried. Krupp, A.-G., Germany. Barrel carriages of the type dealt with in patent No. 494, 1903, are so constructed by the patentee that while being simple in construction they possess lightness in weight and enable an accurate coupling with the gun carriage to be obtained which precludes all movement. Accepted Sept. 10, 1908.

12,963 (1908). **Range Finders.** A. J. Boult, London (Agent for *Société Ponthus and Theodore, Paris*). Range finders provided with an angular micrometer having a telemetric drum described in patent No. 26,813, 1906, are improved. The movement of the object glass for each turn has been increased to obtain a greater angle. Accepted Sept. 3, 1908.

13,170 (1908). **Bolt Action Rifle.** The Birmingham Small Arms Co., Ld., A. H. M. Driver, and G. Norman, Birmingham. In connection with bolt rifles of the type dealt with in patent No. 19,941, 1907, a bolt locking safety device is provided which also acts as a lock for the striker guide nut. Accepted Sept. 10, 1908.

15,496 (1908). **Target Faces.** Capt. H. Kamman and A. Kaszab, Hungary. The face of a target is provided with grooves of wedge-shaped section to prevent bullet splashing. The sides of adjacent grooves meet in a line common to both. Accepted Sept. 24, 1908.

15,619 (1908). **A Cartridge Turnover Machine.** C. Osborne & Co., Ld. and A. E. B. Wilkinson, Birmingham. (*See Selected Patents*).

SELECTED PATENTS.

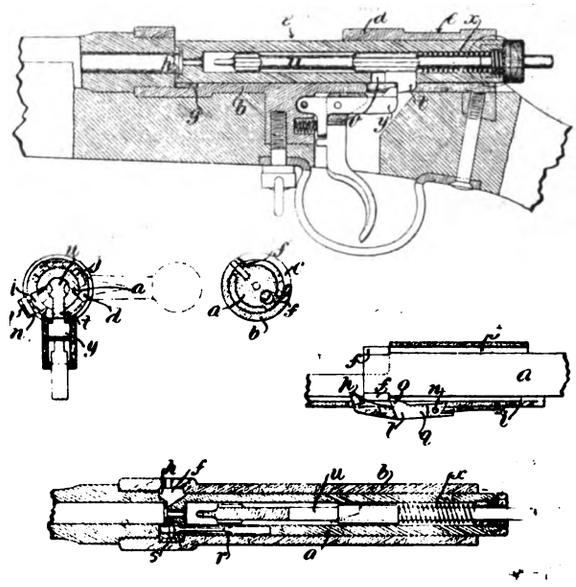
BOLT ACTION RIFLE CONSTRUCTION.

19,941 (1907). The Birmingham Small Arms Company, Ld. A. H. M. Driver, and G. Norman, Birmingham. The object of the patentees in designing this bolt action rifle has been to embody the best features of existing bolt rifles without complication, at the same time introducing some novel arrangements and devices. The arm is stated to be adapted specially for production at low cost from standardized interchangeable components. It is also built so that by a slight change of the loading aperture in the body it can be adapted for any cartridges from the ·22 to the full Service ammunition. The action has been built up specially to allow of the fitting in a convenient place of an aperture sight. The specifications and drawings are necessarily rather full, but the brief description below, and the selected illustrations, will no doubt, convey to the reader a fairly comprehensive idea of the scope of the invention.

As will be seen the bolt *a* is formed of one solid piece, and is mounted in the body *b*. The loading aperture is formed at *c* by machining a gap in the right hand side of the body. The complete sleeve portion *d* is left at the back of the body and serves not only as a rigid and extended bearing for preserving the bolt in correct alignment, but also as a saddle for the reception of an aperture sight at *e*. This is a convenient position and is claimed as a special feature of this rifle. The bolt handle is set at such an angle that the hand of the shooter does not foul the sight when the bolt is opened.

To facilitate the introduction of cartridges into the chamber, the front end of the body is gapped right up flush with the chamber end. Other bolt rifles with forward resistance lugs have an overhanging or hood-like part for the reception of the bolt head. The bolt lugs *f* turn into the circumferential channel *g*, when the bolt is turned to lock the action. This channel is easily got at for cleaning, and the patentees say it is not costly to machine.

On the breech end of the barrel round the chamber is arranged the annular register or dowel *h*. This is adapted to extend rearwardly into a corresponding recess in the bolt head so as to form a gas check and to centre the head of the bolt properly with the chamber. When the bolt is opened or closed the lugs *f* slide in the longitudinal grooves *i*, (cut in the bottom of the body), and *j*, (cut along the inside of the top of the solid sleeve part at the back of the body). These grooves are open-ended so that the bolt may be entirely withdrawn when the bolt stop is removed, and they prevent the bolt being turned during the longitudinal movement. The bolt stop *l* acts also as a cartridge ejector, and



consists of the spring controlled limb pivoted at *n* to the body. The points of *o* and *p* serve as ejector and bolt stop respectively, and part of *q* is sufficiently wide to cover the slot in which the ejector works, and prevent the rearward escape of gases from cartridges which may "blow back." The stop *l* has to be depressed by finger pressure applied to point *p* to allow the bolt to be taken completely out of the body. The bolt may be pushed straight into the body when replacing without manually depressing the bolt stop. Inclines on bolt and stop allow of this. The extractor *r* is of the spring type. It snaps over the cartridge head, and turns on the rim with the bolt during the closing movement. The pin *s* passes through a hole near the nose of the extractor and holds it in position without stopping the necessary play.

The striking and firing mechanism does not entail the employment of a separate cocking piece. When the bolt is turned to open the rifle a cam surface on the bolt acts against the lug *t* on the striker *u* and partially cocks it. The lug *t* extends through the opening *v* in the bottom of the bolt and has several functions. In addition to being the medium through which the striker spring *x* is compressed, and the striker partially cocked during the opening movement it also acts as a key piece to prevent the striker moving in any but a rectilinear direction, and as a "bent" lug with which the trigger part *y* engages when the bolt is closed to fully cock the parts. When the trigger is pulled the striker carries the lug forward, and should the bolt not have been completely closed

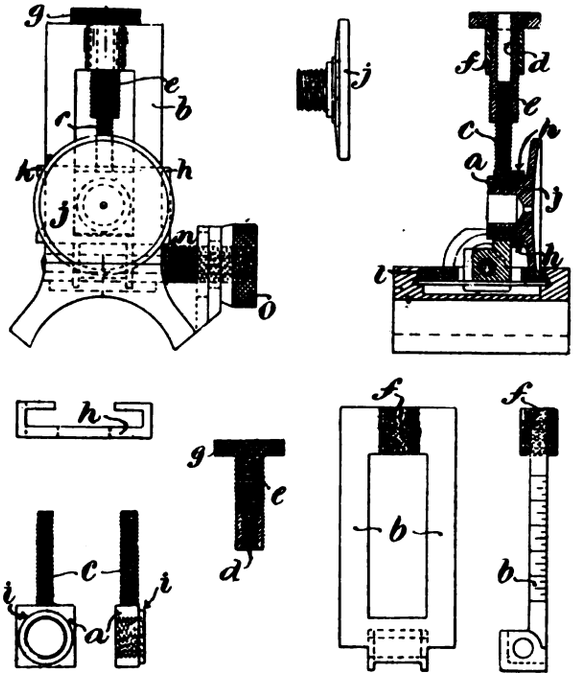
the lug slides over the cam surface on the bolt and turns the latter home before the striker point reaches the cartridge cap. A free and rapid movement of the striker is said to be secured by the arrangements described, the thrust of the compressed striker spring being such that there is no tendency to cant either of the parts out of alignment. Accepted September 3, 1908.

APERTURE SIGHT FOR RIFLES.

26,943 (1907). The Birmingham Small Arms Company, Ld., A. H. M. Driver, and G. Norman, Birmingham. The aperture sight described in this patent consists of an aperture disc of usual form which works on a hinged leaf and is raised or lowered by a double screw of novel design. One screw works in the leaf, and has an opposite pitch of thread to a second screw which works inside it, and which is attached directly to the aperture disc. The double screw secures a movement of the aperture double that of the elevating screw. The sight is also fitted with a screw adjustment for lateral movement.

The accompanying drawings clearly illustrate this new form of sight. The aperture block *a* is arranged to slide up or down in the open central part of the leaf *b*. To the top of the block the screw *c* is fixed. The screw extends upwards and works in the internally screw-threaded part *d*, of the elevating screw *e*, which is also threaded externally, the pitch being opposite to that of the internal screw thread. The elevating screw engages in the threaded hole *f* in the top of the leaf *b*, and has the knurled head *g*.

The aperture block *a* is connected to the slide *h*, which embraces the leaf *b* by the collar *i*, and the aperture disc *j* which is screwed into the block so that the block and slide are held firmly together. No loose screws are used.



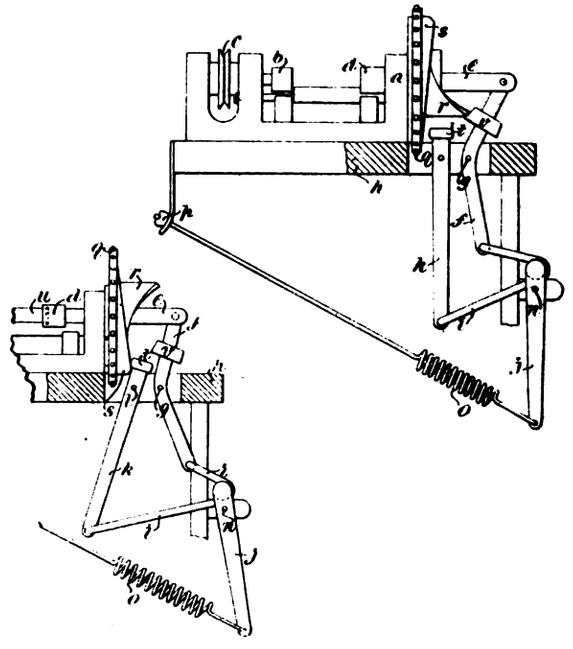
When the knurled head *g* is turned the screw *e* works up or down in the leaf top. This action raises or lowers the aperture block *a* at double the speed of the screw *e* because the engagement of the internal screw thread, (of opposite pitch to the outside thread) with the screw *c* moves the latter upwards or downwards relatively to the elevating screw. The relative rate of travel can be varied by altering the pitch of the threads.

The wind-gauge arrangement consists of the laterally sliding plate *l*, to which the leaf *b* is hinged between knuckles. One of the knuckles is extended into the hollow pin *n* and is threaded externally as shown. The knurled nut *o* is held by the collar standing up from the fixed bed and works on the screw *n*. When the head *o* is turned the screwed pin *n* is moved backwards or forwards carrying the sliding plate *l* and thus the leaf *b* and aperture *j* with it.

Alternative forms of this sight are illustrated and described in the specification. Accepted September 10, 1908.

CARTRIDGE TURNOVER MACHINES.

15,619 (1908). Messrs. C. Osborne & Co., Ld., and A. E. B. Wilkinson. By means of cams on a wheel on the feeding chuck of a cartridge turnover lathe and a system of levers, an even amount of pressure is applied to the cartridge whilst the mouth is being turned over. When the chuck is free and the resistance of the cartridge to the longitudinal movement of the chuck is absent no strain is put on the working parts.



With reference to the appended illustrations the headstock *a* carries the chuck *b* which is rotated by a band through the pulley *c*. The chuck *d* is capable of longitudinal movement, and carries the extending bar *e* connected at its outer end to the lever *f*, pivoted at *g* in the frame *h* of the machine. To the lower end of the lever *f* is fastened a chain or cord *i* which passes round the top of the lever *j* to the bottom end of the lever *k*. The latter is pivoted to the frame *h* at *i*. The lever *j* is pivoted at *n* to a downward extension of the frame, and at its lower end the spring *o* is anchored. The other end of this spring is carried by the frame at *p*.

The chain wheel *q* and its cams *r* and *s* are responsible for the longitudinal reciprocating movement of the chuck *d*. When the cam *s* is turned down the roller *t* on the lever *k* is engaged, with the consequence that the end of the lever *k* is caused to pull the cord *i* round the top of the lever *j*, and so to push the chuck *d* towards the chuck *b* through the turning of the lever *f* on its pivot *g*. If a cartridge *u* lies between the chucks in the course of the turnover operation the spring *o* is brought into play by reason of the resistance to the full movement of the chuck *d*. If, however, this obstruction is absent the cord is allowed to move freely round the upper end of the lever *j* without pulling about the centre, and the spring *o* is not strained. Resistance, therefore, to the movement of the chuck *d* causes a tension to be put on the spring *o*, which reacts with pressure on the cartridge ends.

When the wheel *q* is turned the cam *s* is disengaged from the roller *t* of the lever *k* and the other cam *r* is brought into touch with the mushroom roller *v* on the lever *f*. This forces the lever *f* back on its pivot *g*, and carries the chuck *d* away from the chuck *b*. Accepted September 24, 1908.

Arms & Explosives

A TECHNICAL AND TRADE JOURNAL.

Editorial and Publishing Offices: EFFINGHAM HOUSE, ARUNDEL STREET, STRAND, LONDON, W.C.

No. 195.—Vol. XVI. DECEMBER, 1908. MONTHLY, PRICE 6D. 7d. Post Free.

CONTENTS.

CURRENT TOPICS.

The Elcho Shield Match.—The last scene of all which ends the strange eventful history of this year's competition for the Elcho Shield is comprised in the announcement that the match has been declared "off." The disqualification of Mr. Jones's score for the English team, because the rifle he used proved upon subsequent examination to have a barrel of greater weight than the regulations allowed, was followed by the discovery that the Scottish team, who were awarded the shield as next in order of merit, had fallen into the same error so far as regards one of their members at the last of the three distances over which firing took place. The whole score of the individual in question was declared void, and the Irish team with the spirit of true sportsmen refused to accept a "walk-over." The National Rifle Association in due course accepted the inevitable, notwithstanding any doubt that may exist as to whether they were entitled to cancel the whole result of a match when the principle of lopping off the offending details had already been adopted. No one, however, will care to challenge the policy of expediency which has been sanctioned. Consequently all that remains to do is the writing of a suitable obituary notice in the report, and the pronouncement of a funeral oration by the chairman at the meeting which will be called in the ordinary course of business to adopt the annual report.

Bisley Sight Regulations.—The National Rifle Association tion have shown a praiseworthy desire to consult the practical convenience of manufacturers by issuing at an early date the conditions governing next year's sights for service rifle competitions. Modern methods of repeat manufacture necessitate a long period of preliminary consideration in order that a design when once approved may not require subsequent modification. In the old days of hand-workmanship, improvements were easily introduced; but nowadays a design is stereotyped by virtue of the control exercised by special tools, gauges, fixtures and all the other appurtenances of modern machine shop practice. The user secures an infinitely better made article, but his requirements can only be dealt with in wholesale quantities. From the shooter's point of view, especially those who have not the time to study every technicality of the gunmaker's art, it is most desirable that the various competing designs of back sight should be on view and available for trial during the early months of the shooting season, in order that there may be time for every competitor to equip himself beforehand with the best form of appliance. Competition must of necessity be exceedingly keen between the different manufacturers now that the scope of the eligible sights is extended by the permission to use the base of the existing long-range aperture sight for fixing the adjustable aperture allowed under the new rules. Last year the aperture was authorised, but it had to occupy an unfavourable location with regard to the eye. This led to the adoption of extraordinary devices for bringing the aperture nearer to the eye than could be accomplished by ordinary methods of construction. The resulting tendency to develop along unsound lines has been eliminated by the wider scope of this year's rules. In actual wording they err somewhat in the direction of dictating principles of design in a matter where the inventor should be allowed considerable latitude. The N.R.A. have laid down that all sights must be submitted beforehand, with a view to their due authorisation by the committee. This being so it is unfortunate that they disallow, or at least severely discourage the adjustment of

elevation by means of a screw, a policy which calls to mind one of the early motor vehicle trials in which petrol engines were forbidden because of the unsoundness of the principle they represented.

Mining Risks in America.—No better example of the unity of nations, in the desire to forward the welfare of those employed in peaceful industries, could be found than the recent coaction of *M.* Victor Watteyne, Inspector-General of mines, Belgium ; Herr Carl Meissner, Germany ; and Captain Desborough, H.M. Inspector of explosives, England, who recently visited the United States for the purpose of giving the benefit of their experience in the carrying out of precautionary regulations for diminishing the risks of coal mining. These distinguished experts enjoyed the status of guests of the United States Government during the six weeks of their stay in that country. The report which they issued laid down in precise terms the nature of the precautions which in their opinion should be observed for the purpose of raising the standard of safety in American mines. This report has been accepted by the American Government as being a most valuable guide for use by Congress and by the different State governments in framing legislation on the subject. Our contemporary the *Colliery Guardian* published in its issue of the 13th ult. the full text of the report in question, and from this source certain passages relating to explosives have been reproduced in another portion of this issue. The series of recommendations are exceedingly interesting in a literary sense, in so far that they state with singular clearness and precision the exact points upon which explosives legislation must turn. The avoidance of detail renders the outstanding principles exceptionally convincing, so much so in fact that this précis of the united wisdom of three authorities of international reputation registers the important advances which have been made since the early days of testing gallery experiments.

Unity in the Gun Trade.—A small trade like gunmaking, which is subject to attacks from so many quarters, should at least be united within its own boundaries, and yet Mr. Winston Churchill on behalf of the Board of Trade replied to Mr. Jesse Collings to the effect that certain necessary reforms in proof marking could not be undertaken because the views held by different sections of the English gun trade on this difficult matter are widely divergent. Continuing his reply he went on to say that while the trade is so divided in opinion it was not possible for him to take action in the sense desired by the honourable member. The suggested alterations of law, which formed the basis of the question asked, related to the present system of applying English proof marks to foreign weapons in such a manner as to assist the process of deception, whereby a purchaser is misled into believing that the weapons he purchases are of English manufacture. The principles of justice certainly indicate that when a particular nationality enjoys the reputation of turning out a high quality of work, special precautions should be taken to prevent the fruits of that reputation being gathered by other nations whose products are less highly esteemed by the user. When the test of practical working is applied to these apparently unanswerable maxims it appears that other considerations must receive equal attention. In certain sections of gunmaking English and foreign workmanship are so curiously combined that whilst much of the work is Belgian, some of it is English, and the profit nearly wholly so. Were the partnership dissolved the market would pass over to the foreign worker whose cheap labour is more essential than the English marking. Therefore it is argued : Why definitely sacrifice a small but profitable branch of trade in order to attain a more logical state of affairs, even though the addition of logic implies a deduction of profit ? The question is a very difficult one. Meanwhile, the policy of inaction is likely to prevail so long as an influential minority profit under the existing state of affairs.

The Service Small Arm Cartridge.—Several further replies to questions addressed to the Secretary of War indicate the general line of development which is likely to be pursued in the matter of reforming the ·303 service cartridge. The Small Arms Committee is apparently ruled with an iron hand, its subjects of discussion and investigation being strictly limited to the agenda which is laid down by those in higher authority. The members of the committee may either perform the tasks which are set out for their treatment, or they may resign. The spirit of discipline seems by tradition to be very strong, for the old committee which was told to modify the Lee-Enfield rifle in certain respects did as they were ordered without pointing out that while they were making what practically amounted to a new rifle they might as well be allowed to make a decent job of it. The new cartridge is similarly narrowed in its scope, in so far that it must be constructed in accordance with the restrictions laid down by the limit of strength of the rifle. When reading the replies of Mr. Haldane it must not be forgotten that he was himself a member of the Explosives Committee, and he has shown in various ways a knowledge of ballistic problems in advance of that of an ordinary politician who merely delivers the tale put in his mouth by permanent officials. Therefore when he was reported to state that the present rifle is sufficiently strong and suitable for the purpose for which it is required he was either playing with words, or making statements deliberately contrary to fact. Range judging is undoubtedly a most important element of marksmanship, and a strong rifle action indirectly assists efficiency in this respect by enabling ammunition to be used which minimises the consequences of error. Therefore, a military rifle can never be so strong as is required so long as it is weaker than efficient design and construction can make it. In a similar fashion when Mr. Haldane stated that there are many pros and cons to be weighed in connection with bullets he should have excluded from the argument the adoption of the new pointed formation which in every form gives so great an advantage that each year of delay in its adoption represents a definite loss of efficiency. In fact the whole situation raises the old reflection that the British characteristic is efficiency of the individual and incompetency when they are massed together.

THE ELEMENT OF SAFETY IN RIFLE RANGES.

THE most notable feature about all newly erected rifle ranges is the extraordinary precautions which are taken to prevent the escape of rifle bullets. The country is dotted about with rifle butts, in the nature of railway embankments, topped with vertical bullet-proof screens, all of which are more suggestive of elephant rifles than ·22's, and of 500 yards shooting rather than 50 yards. The origin of this extraordinary nervousness of the consequences of village rifle shooting emanates from Hythe, so far at least as can be judged by the latest handbook of instructions for the construction and inspection of miniature cartridge ranges. It is impossible to read this carefully compiled, and in many respects highly useful, handbook without regretting the old fogey nervousness which pervades nearly every page and passage. An entire rifle meeting may be conducted without making at the back of where the bull comes a hole larger than would comfortably pass an orange. Yet the Hythe experts go to elaborate pains in showing how the roof of a barn may be made impenetrable to bullets by a series of depending planks arranged geometrically so that no single square inch of tile is exposed. Diagrams are actually published for the purpose of proving the inadequacy as a stop butt for ·22 bullets fired at 25 yards of a hill 33 feet high rising from the base of the target. The particular cause of complaint is not that a direct hit would do otherwise than come to rest in the bank, but that a shot striking the ground 10 yards on the near side of the target might, possibly would, rise from the ground at an angle enabling it to pass over the butts. The angle of rise under such conditions would be so steep that the descent would be in the nature of a dropping shot, and yet it is mentioned that such a range, if passed at all, should be passed for short ammunition only.

The question which naturally arises is whether absurdity could possibly go further, and yet it is only necessary to read other passages in the same handbook to equal, if not eclipse, this chance quotation from many other statements on similar lines. That some species of hesitancy took possession of the publishers of the book between the time of passing the final proofs and publication is shown by the addition of an addendum sheet. An endeavour is therein made to hedge somewhat in regard to the recommended restrictions; but the main sense remains as before, viz. that the army authorities are inclined to surround rifle shooting with unnecessary restrictions seriously menacing its natural development. If the same degree of protection were to be carried out in connection with the relatively far more dangerous process of grooming a horse, the animal would be shackled and manacled so that it could hardly wink an eyelid until the attendant had released some retaining catch. The public is already nervous enough about every species of firearm, and the remedy for that nervousness is not the over-elaboration of precautions, but the demonstration that ordinary care suffices to eliminate any element of danger that may exist. Practical commonsense arguments can be adduced to show that the area of rifle butts should not be dominated by the altogether minute proportion of accidentally liberated shots. In the first place the stray shots let off in the course of a year should be so small in number as to be a negligible quantity. Assuming, however, that such things do happen to the extent of one shot for every thousand properly directed towards the target, the question is the amount of harm likely to result. Each spring, when the rook shooting season is on, some millions of cartridges are more or less promiscuously fired, and until the last year or two the bullets ordinarily used were in very few instances, so light as the 40 grains of the ·22 calibre. The ·380 was quite a popular size years ago, whilst more recently the ·300 and ·250 bullets, weighing 80 and 56 grains respectively, have been the accepted ordinary sizes. With bullet weights in the region of, and constantly exceeding, 100 grains accidents practically never happened, although the conditions sound dangerous enough. The explanation of this immunity from accident appears to be that ordinary country neighbourhoods contain a very small number of individuals to the square mile, and as there are a large number of square feet in a square mile the probability of somebody being struck is correspondingly minute. In populated areas the conditions may be slightly different; but as most of the people are either under cover or screened by houses and other vertical structures from the more or less horizontal course a bullet would take, the chances of accident still remain exceedingly remote. Therefore, the question that arises for practical consideration is whether, if the risk is so very minute, it is desirable to take such elaborate and expensive precautions to minimise it still further.

The same officer who was charged with drafting the dimensions of the protecting butts for the Hythe book of instructions would think nothing of taking a rifle and a box of cartridges into the country for the purpose of shooting rabbits, birds and any small objects that presented a favourable mark. Two hundred such cartridges would result in the firing of more stray shots than the rifle clubs of an entire county would lose in the course of a year. The farmer is equally free from any undue sense of nervousness when he sends his bird-scaring boy to protect the newly sown wheat, not with the old-fashioned black powder muzzle loader, but with a modern ·22 and a box of cartridges. These bullets fired horizontally across the fields and aimed especially into tree branches and to strike the ground, so that they may continue their flight with the characteristic hum of the ricochet, spread nervousness and dread in the minds of birds out of all proportion to the effects that can be produced by blank charges. Therefore the ·22 rifle is ever growing in popularity as a bird scaring implement, and all the while that millions of shots in one form and another are fired all over the country in recognition of the remarkable safety associated with ordinarily careful use of these rifles, the War Office lay down a standard of precaution for rifle ranges entirely out of harmony with the teachings of experience and common sense. Colonel Fremantle's report on rifle shooting in Switzerland provides the most valuable evidence that the over-elaboration of safety precautions is quite unnecessary.

THE PIONEER OF POINTED PROJECTILES

IT is impossible, in view of modern developments in military bullets, to withhold from Major John Jacob, C.B., his proper position as originator of the pointed bullet. His title to fame depends on a pamphlet published by Smith, Elder in 1855, but few persons seem to realise that Jacob did not accidently stumble on an idea whose importance he was unable to grasp. Rather did he apply himself to the problems he set out to conquer in the spirit of true scientific enquiry. The scarcity of the pamphlet in question may possibly account for the tardy recognition by posterity of one who undoubtedly knew, but could not make others believe. One comment remains. Measurement of angle at long ranges was then and is now the simplest and the most instructive test of the air resistance of projectiles. The pamphlet is entitled "*Rifle Practice.*" *By Major John Jacob, C.B., of the Bombay Artillery, Commandant of the Sinde Irregular Horse, and on the Frontier of Upper Sinde; Honorary A.D.C. to the Most Noble the Governor-General of India, etc., etc. With two plates. Published by Smith, Elder & Co., 65 Cornhill, London. Smith, Taylor & Co., Bombay, India,* 1855.

"Man has been called a tool-making animal; and it is certain that the perfection of tools and machinery is a clear and certain mark of advancing civilisation, of the progress of the rule of mind over matter, of the development and operation of those laws by which the working of the human brain makes the force of one civilised man equal that of the stalwart limbs of thousands, or even millions, of untaught and ignorant barbarians.

In no country on earth has this been more apparent than in England; to no people on earth have the tools and machinery of the arts been of more importance than to the English. It was said, and truly said, by one of the greatest of modern statesmen, that it was the spinning machinery of Arkwright which enabled England so long to stand alone, and to stand successfully, against the world in arms.

If such be the value of the tools employed in the arts of peace, those used in war must be even of greater importance. On success in war often depends the power to follow peaceful pursuits; on the high state of the art of war, the practice of all other arts may depend. The military art, like all others, can only approach towards perfection by the use of the most perfect tools and machinery attainable.

Yet, notwithstanding this certain truth, it is notorious that the inferiority of the arms used by modern English soldiers, was, for long, a disgrace to the intelligence of the age, and an outrage on common sense, when compared with the high state of perfection to which the manufacture of arms, as of all other tools and machinery, has been brought to in England.

Impressed with the importance of the subject to the policy of nations, and having been a diligent amateur mechanic since childhood, I have, for twenty-five years past, paid much attention to the improvement of rifled firearms, with which I have, during the last ten years, been carrying on a great variety of experiments, on a scale probably almost unequalled, even by public bodies, elsewhere.

The result of these experiments I have, from time to time, freely communicated to Government; in doing so I had no thought whatever of honour or reward of any kind, and in truth I have received but little encouragement from authority. In placing at the disposal of Government the knowledge which I have acquired with great labour and expense, I have been actuated solely by the wish of being useful to my country, and thought that I was doing my duty to the public in making known what might prove of the highest importance to the success of our arms in war. Still under the influence of these sentiments, and at the urgent solicitation of friends, I now give to the public a succinct account of the results of the experiments mentioned above, and of the means by which these were arrived at.

I have prepared a pattern rifle for the army, (specimens of which have been given to Government), lighter, far more handy and convenient in every way than the rifles hitherto in use, of 24-gauge bore only (that is, the spherical ball of which weighs twenty-four to the pound) with which a tolerably good shot can certainly strike an object the size of a man once out of three times, at a thousand yards distance, and of which the full effective range is near 2,000 yards; the ball, at that range, still flying with deadly velocity. These rifles, proposed for the army, I have only sighted up to 1,200 yards, but higher sights could easily be added if necessary.*

The charge of powder used has been small, two drachms only, for a ball weighing one and three quarter ounces; but, if another half pound of weight in the rifle were not objected to, the barrel might be made sufficiently stout at the breech to admit of a three-drachm charge, when the sights now on the rifles would serve for ranges up to about eighteen hundred yards, and the balls would range a thousand yards further, with force and effect. These performances seem astonishing, and no such effect can be produced by the use of balls of lead only, as will be explained hereafter.

The description of my proposed pattern rifle for the army is as follows: Single barrel, thirty inches long, 24-gauge, four-grooved; grooves to take one complete turn in twenty-four inches of length; good locks, mainspring connected with tumbler by link, half-cock little above nipple, trap in butt; full-stocked barrel attached to stock by bands; steel ram-rod with hollow head exactly fitting the small end of the balls; sword bayonet twenty-four inches long (of peculiar form not easy to describe in words) of the best cast steel; case-hardened iron mountings, and no brass or bright metal anywhere about the piece; long folding sight with slide, both the sight itself and its slide to be made with springs to prevent their working loose. Weight of the whole with sword included, nine and three-quarter pounds.

In my opinion, a piece of similar construction, but half-a-pound heavier, so as to admit of making the barrel very stout near the breech, would be best; but the above makes a very beautiful and wonderfully effective weapon. I have

*My pattern rifles for the Army have been made by Messrs. Swinburne and Son, Birmingham. Specimens have been given by me, at the request of the Government of India, to the Honourable the Court of Directors, and others have been forwarded to the Adjutant-General of the Bombay Army.

other pieces, of the same calibre (24-gauge) but made a little heavier, which make excellent practice at a range of 2,000 yards; the balls at that distance penetrating about four inches into very hard dry sunburnt brick; that is, having sufficient force to go through two or more men. Regular practice at a further range than 2,000 yards I have not yet tried; but from what I have seen of the effect at that distance, I am convinced that with these balls which I am now using, a moderately light and perfectly handy rifle may be made to possess as much effectual power at a distance of 3,000 yards as the old two-grooved rifle with the round ball at 300.

A double 24-gauge rifle of mine, by Manton, twenty-four inches long, with the zinc pointed balls two and a half diameters long, and with three drachms of powder, requires a sight two and three-quarter inches high for 2,000 yards; the distance of sight from muzzle being nineteen inches. The other elevations may be judged of from this.

The experiments by which these results have been arrived at extend over a long series of years, but they may be shortly summed up; and only during the last ten years have I had the means and opportunity of carrying them on upon a scale sufficiently large.

I have up to this time had some dozens of rifles made, of all sorts and descriptions, a large proportion of them made for me by the celebrated makers John Manton and Son; while the cost of target walls alone, used in the course of these experiments, amounts to several hundred pounds, and powder and lead have been expended by the ton.

Our rifle practice-ground at Jacobabad is the best possible, being the perfectly smooth, dead level plain of the desert; and the line of targets, stretching away in front of the lines of the Sinde Irregular Horse, has a singular and somewhat formidable appearance, when their use is known. These targets are walls of "Cutcha" (sun-dried) brick, which here attains nearly to the hardness of stone.

There is a small building open to the front for the accommodation of the shooters, and at accurately-measured distances from this, the walls are erected at 100, 200, 300, 400, 500, 600, 700, 800, 900, 1,000, 1,200, 1,400, 1,600, 1,800 and 2,000 yards. The 2,000 yard wall is forty feet high, fifty feet long, and three feet thick, with supporting wing walls and counterforts, plastered and whitewashed on the face; the others are of similar construction, and of size proportionate to their distances; all are marked with circular black bulls' eyes, of one inch radius for each hundred yards, and raised one foot from the ground for each hundred yards of range

The shooting-shed contains various heavy carriages, or rests, with horizontal and vertical screw adjustments, in which rifles can be fixed for trial and fired, instead of from the shoulder. These carriages do not, however, improve the practice, as will be shown hereafter. The rifles which have been here used are of all calibres, from the single 8-gauge of fifteen pounds weight, throwing a ball of near four ounces, to a double 32-gauge weighing six pounds. Such are the apparatus employed. Our proceedings therewith, up to the commencement of the year 1854, are set forth in the following memoranda."

Memoranda on Rifle Muskets for the Army.

JACOBABAD, *March 4th*, 1854.

"For many years past, the writer of this paper has been engaged in making experiments with rifled guns, with a view to determining the best weapon for a soldier. Every species of arm has been tried by him thousands of times, and more than twenty rifles of different sorts have been made for him in the course of these experiments. The result is now communicated, in the hope of its being useful to the public.

It was very early in these trials discovered that the two-grooved rifle has defects which render it quite unfit for the army.

If its ball be made to fit loosely, it is at liberty to roll in the direction of its two grooves, and thus the advantage of rifling the piece is, in some measure, thrown away.

If the ball be made to fit tightly, the difficulty of loading becomes a most serious evil. The two-grooved rifle was, therefore, after trial, rejected.

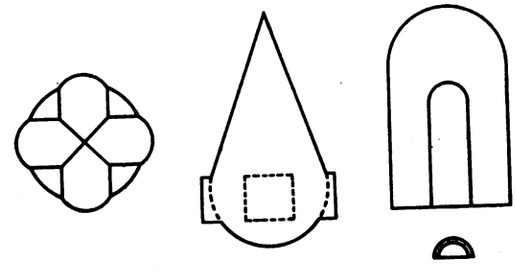


Plate I.—No. 1, No. 2 and No. 3.

The four-grooved rifle with the ball with two bands round it (No. 1 of Plate 1) was then tried, and found to be wholly free from the defects of the two-grooved and poly-grooved rifles. Other shaped balls were also tried; but, as their use has been superseded by others of a better shape, it is not thought necessary to describe them.

The two bands gave such a firm hold on the grooves of the barrel that, though the ball was made so loose as to drop into the barrel and the twist of the rifle's grooves was more than usual, the ball always followed the sweep of the grooves exactly; the gun was more easy to load than even a common smooth bored musket, while in accuracy of performance the piece was surpassed by none. The balls provided for the two-grooved rifle, or the common musket ball cartridge, could be used for it on emergency, if necessary; and the piece seemed to have such important advantages for military purposes over the rifles in use in the army, that the results of the experiments, etc., were, in the year 1846, placed freely at the disposal of the Indian Government.

But the proposed four-grooved rifle was rejected by authority, for the reason that the two-grooved rifle, which was thought good enough for the royal army, was good enough for the soldiers in India.

The best nature of *gun* being now established, experiments were continued to determine the best shaped ball. All manner of forms were tried, until, after a series of experiments carried on diligently for many years, the conical ball (No. 2 of Plate 1) proved *very greatly* superior to all other shapes thought of up to that time. The round ball was

found of little use after 300 yards. This conical ball, though heavier than the round ball of the same calibre in the proportion of three to two, required a charge of powder in the inverse proportion of these weights; that is to say, the charge of the round ball being three drachms, that for the conical ball, with the same range and elevation, was but two drachms.

All manner of rifles were tried, both breech and muzzle loading, of every length, weight, etc., of various twists to the grooves, and of various calibres from 32 to 8-gauge. The conical ball (No. 2) for a long time held its ground against all others; its advantages were overpowering, and excellent practice was made with it at 600 and even 800 yards.

The experiments had reached this point long before the Minié ball appeared; but immediately that invention was known, great things were expected of it, and it was tried in the fairest manner, and on a large scale. The original Minié ball with iron cup is shown in figure No. 3. After long and patient trials, for months together, it was found to *fail completely*.

Under the most favourable circumstances, it never equalled, or even approached, the excellence of the conical ball (No. 2); and it was liable to the enormous defect of having the iron cup blown through the ball, the resulting tube of lead not unfrequently remaining firmly and almost immovably fixed in the barrel. The ball had another great defect; it was cast from the foremost end, so that the roughness left by the ingate of the mould, defects of air-holes, etc., must *occur where the form of the ball was required to be most perfect.*

The Minié ball, to our great disappointment, was then condemned; but others, with modification of the expansion principle, were then largely tried, of all manner of shapes. That shown by figure No. 4 was the most promising; it was made with projections to fit the grooves, so that its hold on the rifles was not dependent on the expansion only; it was

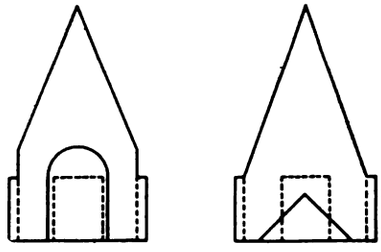


Plate I.—No. 4 and No. 5.
Improved Minié Balls used without Cups.

cast at the hinder end; the conical forepart gave it great advantages in getting through the air; while the hole in the hinder part was reduced in depth, so as to avoid, as it was hoped, the chance of its being blown into a tube. Still this "improved" Minié ball proved on trial no way superior to the ball No. 2; while, though no iron cups were used, still the balls occasionally were blown into tubes, and thus often rendered the gun unserviceable for the time. Figure No. 5 was then tried; and this succeeded well, having apparently some small advantage over the conical ball, No. 2.

It will be observed, that a perfect and very firm hold on the screw formed by the rifle grooves, is given by the projections on the ball, quite independently of the action of the expansion principle; while the conical hollow at the back part of the ball gives sufficient expansion to close all windage when the piece is fired, however loose the ball may be when inserted in loading.

The hold on the grooves of the gun being so great, even with the ball quite loose, it was found that the *twist of the rifles could be increased to any extent* required, without the least danger of what is technically termed "stripping;" that is, of the ball being driven through the barrel without following the sweep of the grooves. The rifles were therefore made with the grooves taking one whole turn in twenty-four inches of length; and this twist was found to answer admirably.

The shape of the ball being found to have such great influence on the resistance of the air to its flight, and the twist of the rifles being found of full power to keep the point of the ball foremost with unerring certainty, even in the longest ranges, the form of the ball was still further studied, till that of figure No. 6 was finally adopted; and this shape,

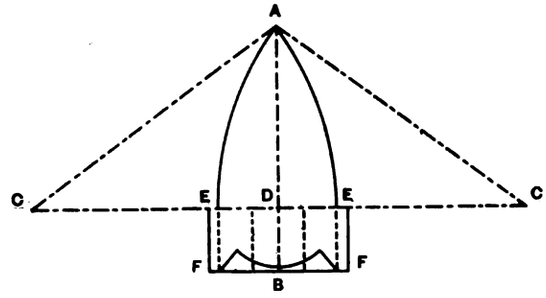


Plate I.—No. 6.
A B = 2 diameters. *A C = 2½ diameters.*
C D = 2 ,, *B D = ½ ,,*
From E to F the ball is cylindrical; from A to E it is defined by arcs of circles described from the centres C, with the radius C A.

after hundreds of thousands of experiments, proves to be quite perfect. Some of the results obtained are most curious.

For instance; the weights of the balls, Nos. 1, 2 and 6, are very nearly in the proportion of each other of the Nos. 2, 3, and 4; but the charges of powder required for them, with the same elevation, are in the *inverse ratio* of their weights: so much is the resistance of the air reduced by the shape of the ball, that No. 6, being double the weight of No. 1, requires only one-half of its charge of powder.

The ball, No. 6, is perfectly and accurately effective up to 1,200 yards, and probably to much greater distances. The effect of its shape in overcoming the resistance of the air is so great, that its progressive velocity, after a flight of 1,200 yards, is but very little reduced; and even at 1,400 yards distance, or further, the percussion shells of this shape burst well.

(*To be continued*).

ROUND THE TRADE.

THE case between Kynoch's and the War Office came on for hearing on the 25th ult., before Mr. Justice Pickford. The proceedings concerned certain deliveries of cordite which were rejected by the War Office on the ground that they contained an ingredient, viz., mercury perchloride not authorised in the contract and specification attached thereto. It has been deemed undesirable to attempt any report of the proceedings up to the stage which had been reached when this issue was due to go to press.

A joint circular dated the 20th ult. announces that the old established business of Robert Hughes & Sons of Moland Street, Birmingham has been acquired by the firm of Joseph Bourne & Son of 7, St. Mary's Row, Birmingham, who will continue to manufacture the same patterns of firearms with which the name of Hughes has been so long associated. The actual formal transfer will take place as from the 31st of this month, and the old firm's customers will have the satisfaction of knowing that the new proprietors have enjoyed 60 years' connection with the same class of trade, a sufficient guarantee that their needs will be studied by those having the experience necessary for satisfying them.

The case of very great importance to dealers in pistols, referred to in last month's issue, was settled by the magistrate entirely in favour of the trade reading of the Act so far as regards the sale of pistols to householders. Mr. Robert Gray, of the firm of Cogswell & Harrison, Ld., was pounced upon as vendor of a pistol to one, William Garton, who committed suicide therewith. This aspect of the case was somewhat unduly emphasised by Mr. Muskett, the prosecuting counsel, considering that the issue had admittedly been raised, solely in the hope of securing from the magistrate a new interpretation of the Act, different from that which had previously been accepted by the police authorities as well as the trade. That the matter appealed to Mr. d'Eyncourt, the Clerkenwell magistrate, in this light was shown by the stress he laid at the first hearing on the great and exceptional care which the defendant had exercised in carrying out what appeared to him, and to others, at the time of the sale, the proper reading of the Act. At the resumed hearing, when the magistrate delivered his considered judgment, he again emphasised his appreciation of the almost extraordinary care taken by Mr. Gray to verify the statements of the purchaser as to the entirely legitimate use to which he intended putting the pistol. Mr. d'Eyncourt explained that the only question for him to decide was whether the words " and produces a statement to that effect signed by himself and by a police officer, etc." in the Pistols Acts 1903 applied only to persons proceeding abroad for a period of six months, or whether they were also to be applied to persons holding a gun or game licence, those exempted from the necessity to take out such licences, and householders. According to his interpretation it could only apply to the last preceding clause relative to persons going abroad, and not to any of the other classifications of purchaser. If, however, all the clauses were to be affected by the one " and produces a statement to that effect " he could not believe that the legislator had it in mind that a field-marshal proceeding on active service, and enjoying exemption under the Gun Licence Act 1870, would also be required to produce a statement to that effect signed in accordance with the Pistols Act 1903, as interpreted by Mr. Muskett on behalf of the police. He accordingly decided that the police certificate was only necessary in the case of persons proceeding abroad, and in giving the decision against the police he awarded the defendant £5 5s. costs. The question of appeal was reserved for further consideration.

An explosion occurred at the Waltham Abbey factory which resulted fatally for a plumber who was engaged in cleaning a lead floor. A small quantity of nitroglycerine had found its way under the floor and upon ignition by a lamp in use at the time it lifted the leaden floor and projected part of it into the man's face.

A good deal of favourable comment has been deservedly bestowed at the recent cycle show on the new B.S.A. bolt rifle which has been introduced for the purpose of competing with American and Belgian miniature bolt rifles. It is exceedingly well manufactured. The over-all size is that of the War Office miniature rifle. The dimensions of the stock, the bolt handle and the other parts entirely meet the complaint that most of the small rifles at present on the market appear to be intended for children's use.

The best loading for Eley's " Lethal " 12-bore bullet is given in the *Field* trial of the same as 46 grains of Schultze or equivalent powders, and 36 grains of Smokeless Diamond or other 33-grain powder. These charges produce a moderate pressure and a velocity of about 1,200 f.s. Higher charges are less satisfactory by reason of the high recoil produced in guns of ordinary weight. The cartridge is wadded in the ordinary manner except that instead of the usual cards each side of the shot, the ball is held in place by two *Field* cloth wads with ⅜-in. holes punched in the middle. An ordinary turnover is given to the mouth of the case.

A meeting of the British South African Explosives Co., Ld. has been called for the 3rd inst. to consider resolutions reducing the capital of the Company from £1,100,000 to £600,000 the reduction to be effected by returning 8s. per £1 share or stock as the case may be. The second and confirmatory meeting will be held on the 18th prox. It is understood that the return of that portion of the Company's capital which cannot be usefully employed arises from the information that the South African mines are entering into contracts with other firms for supplies of explosives at prices below what the Company regards as remunerative.

A recently issued report, approved at the October meeting of the Liége Chamber of Commerce, states that the arms trade was even better last year than in 1906. The number of proofs of all kinds was 2,696,395, against 2,459,241 in the preceding year, while the number of arms proved in the two years was 1,579,479 and 1,502,751 respectively. This flourishing state of affairs entailed an anxious situation for the Liége armourers. Owing to the generally increased cost of production, both as regards labour and materials, the makers were obliged to raise their prices; but even at the higher scale of charges they were unable to keep pace with orders. The subsequent fall in the price of metals has not produced sufficient effect to cover the growing demands of labour. Belgian prices have always made competition difficult by countries where a higher standard of wages prevailed, but the following reasons which have been advanced in justification of a further rise of prices suggest that the disproportion so noteworthy in the past is in the process of disappearance :—First, the greatly increased cost of living in Belgium; second, the recent founding in Liége and its neighbourhood of large factories for motor cars, cycles, dynamos, etc., which have given more remunerative work to arms, operatives and have obliged employers to raise wages; third, a large and unprecedented influx of orders from all the markets at once, also leading to a considerable increase in wages; fourth, the formation of trades unions. The producing capacity of Liége arm factories is at the present time insufficient to execute orders in reasonable time, and the Union des Fabricants d'Armes is said to have sent out circulars in several languages explaining the situation. France remains the best customer, notwithstanding increased activity at Saint Etienne. Orders from Italy have also increased, even since the rise of import duty.

(*Continued on next page*).

It is reported from Slatoust that in the local treasury ironworks the installation of a gun tempering plant has been finished. The construction of this plant was undertaken when an order was received for the production of one hundred three-inch gunbarrels at the price of 990 roubles (£105) each. The main gun tempering plant consists of two furnaces with generators and softener, and also an oil tempering vat with a system of cooling by water. The tempering furnace is of a new type, the invention of the manager of the factory, Mr. Gertum. This furnace is worked with generator gas. Its situation is near the old blast furnace, which is now out of action.

The gross profits of the Société Centrale de Dynamite in 1907–08 amounted to £40,457, as compared with £43,900 in the preceding year, and the sum of £36,888 out of the former was derived from interest on shareholdings, as against £41,944 in 1906–07. According to the directors' report, the smaller yield on investments was mainly due to a reduction of the dividend in the Transvaal Dynamite undertaking from 6½ to 5 per cent. The net profits of the French company were £37,033, as contrasted with £39,623 in 1906–1907, and a dividend has been declared at the rate of 32 francs per share on a capital of £560,000, as against 34 francs in the previous year. The shareholdings represented on 30th June a depreciation of £80,000, as compared with the quotation on that day, the amount being covered by the reserve fund.

The *Ironmongers' Chronicle* of October 31st reports a meeting of the North-West Devon Ironmongers' Association held at Ilfracombe at which questions concerning guns and cartridges were discussed. In the former matter a complaint was lodged that a particular gun was priced at £18 in a shop, whilst it could be obtained direct from the wholesale firm retail at £10. It was further pointed out that several names covered the personality of one firm. It seems that a Mr. Meredith introduced the question of the cartridge trade, and a subsequent speaker suggested that this trade was gradually finding its bottom, and he referred with satisfaction to the increasing number of price-maintained cartridges. Members criticised the practice of certain firms in the habit of selling both price-maintained and non-maintained cartridges. The chairman expressed the belief that it would be most desirable for a definite basis of prices to be maintained all round.

The small arms trade is to be made the subject of a census of production enquiry on the same lines as the explosives trade, the arrangements in connection with which were referred to at length a month ago. The same general form is being adopted for all industries, the protection of anonymity being fully assured in respect to all information supplied. The sections of production for the small arms trade are as follows:—(1) sporting guns, carbines and rifles; (2) military rifles and carbines; (3) miniature and cadet rifles and carbines; 4 air-guns and rifles of all sorts; (5) revolvers and pistols; (6) tubes to be made into barrels of firearms; (7) other parts of small arms; (8) swords, cutlasses, bayonets, and arms of other sorts, not firearms. Gun implements occupy so important a position that it is difficult to justify the absence of a special section devoted thereto. There is certainly an additional list for the specification of all other products of the firms receiving the form, but this is rather a miscellaneous section in which to throw what is undoubtedly a recognised branch of the trade, with ramifications which extend into other businesses. Whilst the leather accessories of the gun might be credited to the leather trade, and the telescope sight sections to the optical trade, the making of the hundred and one implements essential in the practical employment of guns and rifles are undoubtedly worthy of special mention.

FROM the Cotton Powder Company two interesting pamphlets have been received, the one containing notes and snap-shots of the public demonstration of the Hale rifle-propelled grenade, the other a most carefully compiled and cleverly illustrated description of the new patent safety delay-action fuse, by Mr. Marten Hale, the same being for use in connection with wet guncotton bursting charges for shells. The principle of the delay-action rests upon the forward motion on impact of a plug carrying a striker tip for operating a percussion cap. The delay between impact and explosion is controlled by the distance of travel of the firing plug.

Mr. Oscar Guttmann delivered the first of a series of four lectures, known as the Cantor series, before the Royal Society of Arts on the 23rd ult. The second lecture was dated for the 30th ult., after this issue went to press, whilst those still to come are due for the 7th and 14th inst. respectively. The subject is 20 years progress in explosives, and as Mr. Guttmann is seen at his best in reducing to order a mass of statistics, from which the ordinary mind recoils, it will be better to deal in a general way with the series as a whole when issued in published form, than to attempt to summarise what is already a summary of the most condensed and concentrated order.

Those interested in freak inventions will do well to read the specification of Patent. No. 6,845, 1908, by Hiram Percy Maxim, the same dealing with the device for lessening the sound of discharge of firearms which was so much discussed in the newspapers a few months back. The arrangement is amusingly obvious in that a trap door closes behind the bullet and bottles up the gases whose subsequent escape in an orderly fashion is regulated by a valve. The essence of such an invention is the means adopted for operating a valve during the period a bullet travels, say, one inch. The bullet itself gets up velocity in gradual accelerations spread over 30 inches, and it is brought to rest by more or less violent impact. The valve should do more. To be effective it must accelerate to 2,000 f.s. velocity in ·00004 of a second or thereabouts, and it must be brought to rest in much the same period without damage to any of its parts. Moreover, it must stand the hammer blow of some 30 grains of gas moving at a high rate of speed. In other words the noiseless gun introduces a revolutionary theory, and there is at present only print and paper to prove its soundness.

REVIEW.

Artillerie de Campagne by Colonel J. Paloque. Fortification Cuirassée by Colonel L. Pairron de Mondesir. Volumes of the Encyclopédie Scientifique. Published by Octave Doin, Paris. About 400 pages each. Price 5 fr. each.

Of all instruments of war artillery must be given the premier position, and, therefore, a book on this subject appeals to the general reader as well as the military. The text book on field artillery by Col. Paloque can be read by those who have not previously studied the subject as a science. It, therefore, forms a very useful introduction to artillery. There are six chapters, viz., History of Artillery, Modern Artillery, Accuracy of Fire, Effects of Fire, Organisation and Artillery in Action. The subject is treated in rather an abstract manner, and this adds to the value of the book, because the general principles underlying the evolution of artillery are not masked by details of construction, interesting and intelligible only to the advanced artillerist. The volume on armoured fortifications by Col. Pairron de Mondesir is a contribution to a subject at present possessing only a very small literature. This text book consists of two equal parts. The first deals with the evolution of fortifications during the eighteenth century, and the second with its present state. The book ends with a chapter on the probable immediate improvements in armoured fortifications.

N.R.A. RIFLE SIGHT REGULATIONS.

THE National Rifle Association caused to be published in their official organ the *Territorial Service Gazette* the following notice concerning the sights for service rifle competitions for next year. The first notice appeared in the issue of Oct. 21, but the wording was slightly modified so that the following wording from the issue of the 4th ult. may be taken as the latest official rendering of the rules in question :—

General conditions which must be fulfilled in any sights that may be approved for use at the 1909 *Bisley Meeting* :—

(*a*) Sufficiently strong and suitable for military purposes.

(*b*) There should be no unnecessary projections.

(*c*) The aperture, if used, should be capable of adjustment for elevation, so that the elevation, for instance, for 800 yards, should be about the same with the **V** (or **U**) as for the aperture.

(*d*) The aperture should not be too small

(*e*) There should be one fixed **V** (or **U**)—*i.e.*, a "battle sight"—to give elevation, say, for 500 yards.

(*f*) The windgauge should be worked by a screw, unless a device can be invented to prevent accidental displacement.

(*g*) The slide should not be elevated by a screw, but there is no objection to a screw for fine adjustment.

(*h*) The whole slide should be as little clumsy as possible ; if at all heavy, it is quite necessary to have a clamping screw.

(*i*) There is no objection to an extension of the sight to alter its position on the barrel.

(*j*) There is no objection to adapting the existing dial sight or aperture sights.

(*k*) The sight to be attachable to the rifle as issued, by the withdrawal of the hinge-pin or screw of the existing sights and its re-insertion only.

All sights to be used for 1909 must be submitted to the National Rifle Association not later than Jan. 1.

SUGGESTED MINING LEGISLATION IN AMERICA.

THE following are the passages relating to explosives of the joint report of *M.* Victor Watteyne, Herr Carl Meissner, and Capt. A. Desborough to the United States Government laying down the needful points for coal mines legislation in that country :—

A.—SELECTING THE EXPLOSIVE TO BE USED.

(1) We recommend that the Government of the United States examine the explosives now and hereafter used in mining, with a view to eliminating the more dangerous explosives and to improving and standardising such explosives as may be considered most suitable for such use, these to be designated by the Government "permissible explosives."

The term "permissible explosives" is suggested for the reason that no explosives are entirely safe, and all of them develop flame when ignited ; and we advise, therefore, against the use in the United States of the terms "safety explosives" or "flameless explosives," as these terms may be misunderstood and this misunderstanding may endanger life.

(2) We recommend that the operators and miners of coal use only such explosives as are included in a list of "permissible explosives," when the same has been published by the Government, in all mines where there is risk of igniting either dust or gas, selecting that one which their own experience indicates can be used to the best advantage under local conditions.

(3) We also recommend that investigations be conducted to determine the amount of charge of such "permissible explosives" which may be used to the best advantage under different conditions with a view to reducing danger to the minimum.

B.—CARRYING THE EXPLOSIVE INTO THE MINES.

(1) All explosives should be made into cartridges and placed in closed receptacles before being carried into the mine, and the quantity carried into the mine during one day by any miner should be limited as nearly as practicable to the quantity needed by him for use during that day. Handling loose explosives and making them into cartridges by an open light in the mine should be prevented.

(2) Detonators or caps should be handled with great care, and should be carried only by a limited number of responsible persons.

C.—USE OF EXPLOSIVES IN THE MINE.

(1) Shooting in or off the solid should not be practised.

(2) The depth of the shot hole should be less by at least 6ins. than the depth of the cutting or mining. The use of very deep shot holes should be avoided as unnecessarily dangerous.

(3) The overcharging of shots (the use of a larger charge than is required to do the work satisfactorily) should also be avoided as unnecessary and dangerous. The proper standardisation of explosives used in coal-mining will greatly facilitate the carrying out of this recommendation.

(4) Shots should never be tamped with fine coal or material containing coal. Clay or other suitable material should be supplied and used for this purpose.

(5) The firing of two or more shots in one working place, except simultaneously by electricity, should not be allowed until a sufficient interval has elapsed between the firings to permit an examination of the working place, in order to see whether any cause of danger has arisen.

(6) Before a shot is fired the fine coal should be removed from the working place, as far as practicable, and the coal-dust on the floor, sides and roof, for a distance of at least twenty yards from the place where the shot is to be fired, should be thoroughly wet, unless it has been demonstrated that the dust in the mine is not inflammable.

(7) If gas is known to occur in the mine, no shot should be fired until, in addition to the watering, an examination made immediately preceding the time for firing, by a competent person using a lamp which will easily detect 2 per cent. of gas, has shown the absence of that amount of gas from all spaces within twenty yards of the point where the shot is to be fired.

(8) Believing that such will be one of the greatest advances which can be made in safeguarding the lives of the miners, we recommend the adoption of a system of electric shot-firing in all mines where practicable, by which all shots in the mine, or in each ventilation district of the mine, may be fired simultaneously, at a time when all miners and other employees are out of the mine.

Messrs. Bentley and Playfair, Ld., have recently removed their London show rooms from Queen Victoria Street to more commodious premises at Atlantic House, Holborn Viaduct, E.C., where they they have on exhibition under the best conditions an extensive series of sporting guns, comprising a variety of grades, the best of which are a high testimonial to the quality of work the firm are able to turn out.

APPLICATIONS FOR PATENTS.

OCTOBER 19—NOVEMBER 14, 1908.

22,102. Range Finders. Sir W. H. M. Christie.
22,202. Ordnance Sighting Gear. R. W. B. Billinghurst.
22,265.* Small Arms Projectiles. A. C. Curtis.
22,283. Cartridge Cases. W. D. Fox.
22,555.* Explosive Compounds. G. Lezinsky.
22,703. Ordnance Sighting Apparatus. A. T. Dawson and G. T. Buckham.
22,774. Rifle Sights. J. E. Martin.
22,823.* Percussion Fuse Locking Mechanism. Fried Krupp.
22,835. Assembling Base Wads, etc. of Cartridges. Nobel's Explosives Co., Ld. and H. D. Hodge.
22,843. Ordnance Breech Mechanism. A. T. Dawson and G. T. Buckham.
23,088. Cover Plates of Small Arms. L. B. Taylor.
23,127.* Fuse Setting Machines. Fried Krupp.
23,173.* Telemeter. Optische Anstalt C. P. Goerz.
23,187.* Automatic Firearms. R. H. Kjellman.
23,200.* Automatic Pistol Firing Mechanism. Webley & Scott, Ld. and W. J. Whiting.
23,299. Sighting Devices. T. Gilbert-Russell.
23,307. Ordnance Sighting. L. K. Scott.
23,404. Rifle Sights. E. Harrison and G. Phillips.
23,640. Targets. L. Jeffries.
23,764. Sharp Shooting Practice Apparatus. F. R. S. Milton.
23,833.* Firearms. A. D. Chronis.
24,120. Firearms. H. W. Gabbett-Fairfax.
24,121. Firearms. H. W. Gabbett-Fairfax.
24,122. Firearms. H. W. Gabbett-Fairfax.
24,123. Firearms. H. W. Gabbett-Fairfax.
24,228.* Cartridge Belts. The Mills Equipment Co., Ld.
24,433. Relieving Weight of Gun when not Firing. W. T. Pugh.
24,531. Eye Protector for Telescopes. C. R. C. Hart.

*These applications were accompanied by complete specifications.

SPECIFICATIONS PUBLISHED.

OCTOBER 22—NOVEMBER 19, 1908.

COMPILED BY HENRY TARRANT.

14,763 (1907). **Ordnance Projectile Construction.** W. E. Lake, London. (Agent for *A., R., and S. Cabella, Italy*). In patent No. 12,373, 1907, these inventors described a projectile with a cutting edge adapted to cut a circular piece out of the armour plate to allow the projectile to pass through. This cutting edge is protected by a cap of soft metal of ogival shape. The particular point of the present invention is that the body of the projectile is grooved so that bulging of its centre on impact is prevented. The diameter of the projectile is not increased on impact and it may pass freely through the hole in the armour plate. Accepted Sept. 28, 1908.

20,439 (1907). **Rustless Iron Cartridge Case.** S. O. Cowper-Coles, London. Iron cartridge or detonator cases are stamped in the usual way (Iron is cheaper than brass generally used). The cases are annealed in pure hydrogen gas, in the manner set out in patent No. 23,664, 1906, and are afterwards coated with zinc by electrodeposition in an apparatus such as is dealt with in specification No. 4,051, 1907. The annealed and coated iron cases are then subjected to a further annealing process in the presence of hydrogen gas in order that the iron may absorb the zinc. The iron zinc alloy so formed on the surface is non-corrosive. Accepted Sept. 10, 1908.

21,463 (1907). **Aim Recording Apparatus.** J. B. Bolitho, Exeter. The apparatus described in this patent is attached to a rifle to record the aim and it is claimed that it does not interfere in any way with the holding or manipulation of the arm. The position of the rifle at the moment of firing is indicated on the usual form of small target but in this case it is attached to the fore end near the bolt. Accepted Oct. 27, 1908.

22,282 (1907). **A Pocket Automatic Pistol.** B. Clarus, Belgium. (*See Selected Patents*).

22,354 (1907). **Target Practice Apparatus.** F. Mitchell, London. The rifle used with this aiming apparatus is kept as nearly like the Service arm as possible by making a chamber in the fore end in which the indicating devices and the miniature target are placed. The rifle is mounted on a yielding standard which allows of wide aiming movements without placing undue strain on the apparatus. Accepted Oct. 12, 1908.

22,880 (1907). **An Air Rifle Target.** G. Norman, Birmingham. (*See Selected Patents*).

26,226 (1907). **Cartridge Loading Machine.** W. E. Lake, London (Agent for *S. Berti, G. Bonavia, and S. Negrai, Italy*). A machine for loading shot cartridges into which is introduced a simple means for feeding the cartridge cases. During this operation they are held by their rims to prevent deformation of the tubular portion. Improved means for loading up the powder and shot are also described. Accepted Oct. 21, 1908.

24,025 (1907). **Explosive Charges.** The Anglo-French F. & S. Ld., and Lieut.-Gen. Sir J. B. Edwards, K.C., M.G., C.B., London. With nitroglycerine and nitrocellulose explosives when in the paste stage from 2 to 7 % of carnauba wax and 2% of bicarbonate of soda are incorporated. The explosive is rolled after it leaves the vat, is then incised, and is afterwards again rolled. It is claimed that this explosive burns progressively and completely, does not flame at the muzzle and that report is diminished. Accepted Oct 29, 1908.

25,250 (1907). **Ordnance Breech Mechanism.** W. Beardmore & Co., Ld., and A. Bremberg, Glasgow. The type of ordnance breech mechanism fitted with the "de Bange" obturator is dealt with in this patent. This mechanism is partly withdrawn before it is swung out of the breech. The patentees describe an improved and simplified construction of the actuating mechanism. Accepted Oct. 1, 1908.

26,438 (1907). **Delayed Action Projectile Fuses.** F. M. Hale, London. Delayed action fuses are so constructed that should they be prematurely fired in the gun or during transit a diaphragm, which is sheared only when the shell strikes, retains the flash so that it cannot communicate with the explosive bursting charge. Accepted Oct. 15, 1908.

1,369 (1908). **Ordnance Sighting Gear.** A. F. Petch and R. Redpath, London. Automatic correction for drift is made, when howitzer sights are set for elevation, through a cam which is pivotally attached to the bracket which carries the endless elevating worm. The cam deflects the bracket by means of a pin or roller. Accepted Oct. 29, 1908.

6,845 (1908). **Report Silencer.** Hiram Percy Maxim, U.S.A. The muffling of the sound of discharge of firearms by interposing at the rear of the bullet, after it has passed a point near the muzzle a transverse valve which holds back the gas until it can be noiselessly vented by gradual escape. The valve contains an arrangement for its automatic operation by means of the gases themselves. Accepted August 6, 1908.

8,894 (1908). **Recoil Mechanism of Ordnance.** Col. H. C. L. Holden, F.R.S., R.A., Woolwich. In order to ensure that guns having firing mechanism actuated by a trigger situated on a non-recoiling part shall always return to a uniform position of rest, the patentee constructs the control ram so that when the gun has run out to a certain point the passage for the escape of the liquid from the control cylinder is temporarily enlarged so that the gun may complete its stroke practically unchecked. Accepted Sept. 3, 1908.

8,895 (1908). **Electrical Firing Mechanism for Ordnance.** Col. H. C. L. Holden, R.A., F.R.S., Woolwich. In order to remove certain disadvantages due to the present weakness of the point of the firing needle the reciprocating locking slide is combined with a block of conducting material which is insulated from the slide and makes contact with the entire head of the firing tube. Accepted Oct. 22, 1908.

10,204 (1908). **Cartridge Shell Feeding Machine.** H. D. Hodge, Waltham (late of *U.S.A.*). The machine described in this patent is adapted to take shells automatically from a hopper and to deliver them to a machine situated below. The shells are so fed that their mouths are always uppermost. Accepted Oct. 22, 1908.

10,228 (1908). **Small-arm Firing Mechanism.** Capt. F. D. Ely, U.S.A. Army. The pendulum mechanism introduced into rifles to prevent discharge should a certain angle of elevation be exceeded is improved. The vertical angle may be altered by varying the position of the point of suspension of the pendulum. Accepted Oct. 29, 1908.

10,312 (1908). **Elevating Apparatus for Light Guns.** A. Vickers, London. (Agent for *Deutsche Waffen, Und Mf., Germany*). Elevating apparatus for light guns of the type carried in collapsible mountings and having a folding lever between the elevating gear proper and the pivotal frame, is simplified and rendered more compact. An additional joint is provided in the folding lever to enable one of the members to be extended lengthwise. The worm sector and the worm of the gear are also adapted to be readily disengaged. Accepted Oct. 22, 1908.

10,623 (1908). **Indicator for Automatic Pistols.** O. Imray, London. (Agent for *Colts Patent Fire Arms Co., U.S.A.*). An indicator is yieldingly supported in the breech bolt and has a part which projects into the cartridge chamber when the bolt is closed. If a cartridge is present in the chamber the indicator is displaced so that it may be detected by sight or touch. This is stated to be of especial use in automatic arms. Accepted Oct. 1, 1908.

11,809 (1908). **An Aperture Sight for Small-arms.** The London Small Arms Co., Ld., F. W. Bennett and C. S. Bayley, London. (*See Selected Patents*).

11,981 (1908). **Safety Device for Automatic Rifles.** P. Mauser, Germany. A safety device for automatic guns consists of movable locking parts arranged on the lock casing. These prevent the loading of the arm should the breech mechanism be defective or should it have been incorrectly put together. Accepted Oct. 8, 1908.

12,231 (1908). **Barrel Recoil Ordnance.** H. Lehmann, Germany. By means of two springs which act independently of each other the breech of barrel recoil ordnance may be automatically opened and closed. The springs are compressed during the recoil movement. One exerts its stored up energy in automatically opening the breech and the other in closing it. Accepted Oct. 15, 1908.

12,762 (1908). **Telescopic Sight for Ordnance.** C. Zeiss, Germany. The telescopic ordnance sight dealt with in patent No. 6,041, 1907 is improved. Two reflecting prisms are introduced, the one rotatable and the other fixed. Certain advantages are claimed. Accepted Oct. 29, 1908.

16,814 (1908). **Field Gun Mounting.** Société Schneider & Cie, France. To allow guns fired at high angles of elevation to be loaded at any elevation it has become necessary to situate the breech as near the trunnions as possible. Balancing mechanism consisting of accumulators has been introduced but is stated by the patentees to be complicated. They prolong the cradle therefore and at its rear end attach a counterweight. The prolonged cradle forms a continuous guide for the gun during recoil. Accepted Oct. 22, 1908.

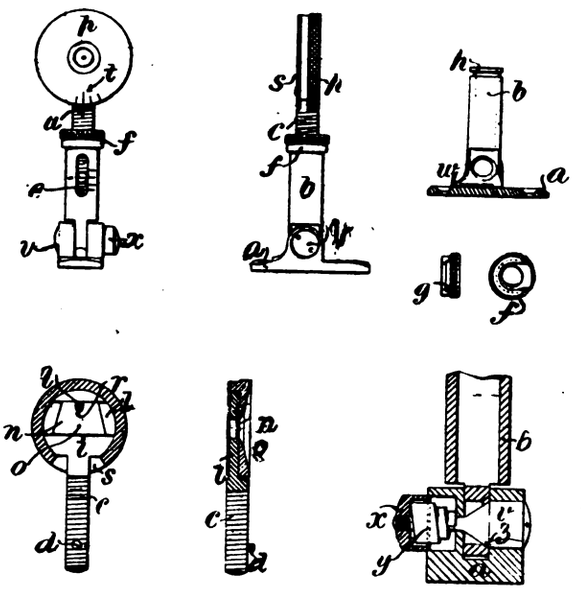
17,696 (1908). **Projectile Fuse Protectors.** L. D. de Lanneau, Paris. An improved cap for fuses consists of a single rigid piece of metal with an external supporting collar. The lower edge of the cap is closed over or crimped into a shoulder or groove on the nose of the projectile or on a ring fixed between fuse and projectile. Accepted Oct. 22, 1908.

19,451 (1908). **Gun Sights.** F. L. Putney, U.S.A. Two separate circular parts carry wires of the kind used in gun sights. By means of a small system of gearing the relative positions of the supports may be changed so that the angle of intersection of the wires may be altered. Accepted Oct. 29, 1908.

SELECTED PATENTS.

AN APERTURE SIGHT FOR SMALL ARMS.

11,809 (1907). The London Small Arms Co., Ld., F. W. Bennett and C. S. Bayley, London. An aperture backsight, somewhat of the well known Lyman type in appearance, is described in this patent. The object of the inventors has been to introduce a sight of this description which shall have means (1) for lateral displacement of the aperture sighting hole to allow of compensation being made for side diversion of the bullet due for instance to wind, (2) for correct vertical adjustment for elevation, and (3) for hinging the sight on to the base by which it is fixed to the rifle, so that there shall be no shake.



The sight is clearly illustrated in the drawings here reproduced. To the base *a* the tubular part *b* is hinged. The tube carries the stem *c* which is guided therein and prevented from turning by the stud *d* working in a slot *e* in the side of the tube. The stem is screw threaded in order that it may be worked up and down in the tube by the nut *f* which is also threaded on its interior. The nut *f* is engaged at *g* with the collar *h* on the top of the tube *b* to prevent vertical displacement.

The circular portion *i* forms the top part of the stem *c*. It is provided with the central hole *j* and the longitudinal slot *l*. In the latter the plate *n* is mounted so that it can be operated from side to side of the circular part *i*. This plate *n* is bored at *o* to form the sighting aperture.

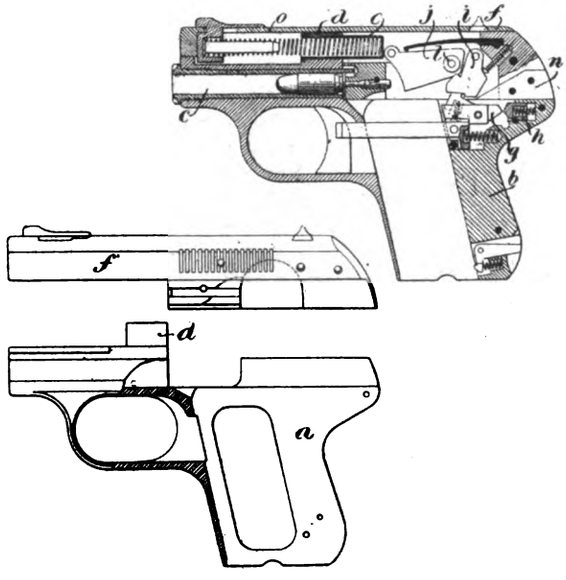
The front of the circular top *i* is covered by the shallow cup part *p* the periphery of which is knurled or checked so that it may easily be turned by the fingers. Inside the cup is a stud *q* which is adapted to engage in a slot *r* formed in the travelling aperture plate *n*. The cup is secured on the sight top by screws which attach it to the back plate *s*. It is obvious that when the cup is rotated the travelling aperture plate *n* is moved either to right or left in a line at right angles to the axis of the stem *c*. To indicate the amount of side movement the front of the cup is scaled at *t*, and the stem has an index line at *u*. As the scale is further from the centre of rotation than the stud and slot *o* and *q*, movements of the aperture are magnified by the scale. Minute movement is thus easily indicated.

The hinging of the sight to secure a solid foundation when the sight is in the vertical or sighting position consists of the combination of the taper bolt *v*, the nut *x* and the spring *y*. The spring is always endeavouring to pull the bolt *v* inwards with the consequence that its inclined surface at *z* is pulled hard down on to the inclined part of the lug at the bottom of the tube *b*. The broad foot *w* of the stem is thus pressed and bedded down firmly on to the base of the sight so as to solidify the standing of the structure. Accepted October 28, 1908.

A POCKET AUTOMATIC PISTOL.

22,282 (1907). B. Clarus, Belgium. The pistol described in this patent consists essentially in the combination of a fixed part—the barrel and stock, and a movable part—the breech slide. The firing parts are arranged in the slide. The parts are condensed into a small space and the main object of the invention has been to produce a pistol suitable for the pocket, pleasing in appearance, and easy to make.

The drawing will give the reader an idea of the construction of the weapon. The stock *a* is forged and shaped from one piece of metal and the connecting part *b* for the rear of the grip of another. The stock is cut out to receive a magazine of the usual kind and



the barrel is either bored in the front part of the stock and body forging or forms a separate detachable tube *c*. The body carries the upwardly projecting eye *d*, in which the returning spring sleeve *e* is situated. The breech slide *f* carries the firing mechanism —bar the trigger parts—and is forced back by the recoil of each cartridge. The parts are cocked as shown in the illustration. When the trigger is pulled the rod shown forces the sear retaining part *g* backwards so that with the co-operation of the spring pushed stud *h* it turns the sear *i* about its pivot and releases the hammer *j*. The discharge takes place, the casing *f* and firing mechanism are forced back, the roller *l* on the hammer rolls up the inclined plane on the part *n*, the sear and hammer bents are re-engaged and the spring *o* forces casing and parts forward again to their original position. Meantime the trigger is released so that the sear retaining device may resume its normal position ready to turn the sear when the trigger is again pulled. The weapon cannot automatically discharge the whole of its contents with one pulling of the trigger. The latter must be pulled to discharge each shot. Accepted Oct. 8, 1908.

AN AIR RIFLE TARGET.

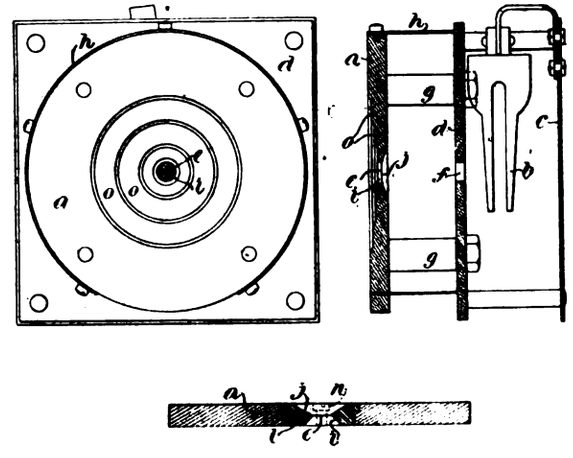
22,880 (1907). G. Norman, Birmingham. Target for use in air rifle shooting generally consists of a plate of hard metal with a hole in the centre representing the "bull's-eye" through which pellets pass and strike a bell at the rear of the plate. A splash on the newly whitened surface of the plate indicates the position of the hit if a "bull" is not scored. The patentee shows that split shots are sometimes experienced with the usual form, *i.e.*, a pellet strikes the edge of the bull's-eye hole and half of it only passes through and rings the bell. The construction of target dealt with in this patent is intended to overcome the difficulty, and to allow only whole pellets to pass right through to the bell.

Between the front target plate *a* and gong *b*, which is carried by the back plate *c*, an intermediate splash-interceptor plate *d* is arranged, which will, as will be described, prevent the bell being struck by pellet splashings or fragments arising from split shots or otherwise, but will still admit of the said bell being sounded by any pellet that has passed properly through the bull *e*. The interceptor plate *d* is mounted immediately in front of the gong and is formed with a central aperture *f* which is arranged in line with the bull of the target plate. The latter may be arranged at any suitable distance in front of the interceptor plate, to which it may be connected by studs *g* and nuts, whilst the space between the two plates is preferably enclosed by a casing *h*, the bottom of which is cut away to provide a clearance for the pellet fragments to fall through. The top may be fitted with a spirit-level attachment to facilitate the adjustment or setting of the target with the holes in the two plates in the same horizontal plane.

To prevent other than clean bull's-eye shots from passing through the holes in the two plates, and thus sounding the gong, the front of the aperture *e* of the target plate, is coned at *i*, so as to form a sunken deflecting surface concentrically around the aperture. Any pellet which would with the ordinary target, strike the edge of the aperture and be split or divided, is deflected by the coned surface and although the pellet (or parts of it) may still pass through the target-plate bull, it is deflected from its original line of flight, and is constrained to proceed at a tangent, or in such a direction that it cannot pass through the aperture in the interception plate, but will strike against it and be caught. The rear side of the hole *e* is also coned or countersunk as at *j* so that there is no obstacle to interfere with the changed flight of the deflected pellet or fragments.

The deflecting surfaces may be formed in the metal of the target plate itself, or as is shown in detail as a separate and renewable centre piece or attachment *i*, preferably of hardened steel being locked in position and prevented from becoming loose by a set strew *n*. The centre piece may be secured in any other convenient manner.

The front or face of the target is subdivided by means of rings into concentric spaces *o* of different scoring values, as usual, whilst in order to prevent a pellet which strikes at the edge of



one space from splashing or spreading into the next space and so creating scoring difficulties, the face of the target is stepped so that each successive concentric space *o* lies in a dissimilar vertical plane to the other spaces and is separated therefrom by a step or shouldering which serves to prevent any part of a pellet that may strike in one particular space of the target, from spreading into the next space.

In targets constructed as above described the distance between the target plate, with its deflecting surface, and the interception plate may, if desired, be arranged so that in the event of only the extreme edge of a pellet striking at the side or edge of the aperture *e*, the slight deflection which will occur shall not prevent the pellet passing through the aperture in the interceptor and ringing the bell; that is to say, the plates may be set so closely together that a pellet which is fired so accurately as to suffer only slight deflection shall nevertheless be admitted to pass through to the bell. Accepted Sept. 3, 1908.