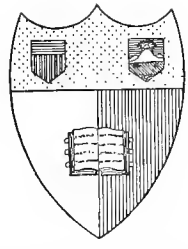

THE JAMES VERNER SCAIFE
COLLECTION

CIVIL WAR LITERATURE

SHRAPNEL SHELL

IN ENGLAND AND IN BELGIUM.

THE

SHRAPNEL SHELL

IN ENGLAND AND IN BELGIUM,

WITH

SOME REFLECTIONS ON THE USE OF THIS PROJECTILE IN THE LATE CRIMEAN WAR.

A HISTORICO-TECHNICAL SKETCH

BY

charles
MAJOR-GENERAL BORMANN,

AIDE-DE-CAMP TO HIS MAJESTY THE KING OF THE BELGIANS.

Die höchste Kraft der Artillerie liegt zur Zeit noch in der möglichst vollkommenen Beherschung der Feuers ihrer Hohl-, Hagel- und Brand-Geschosse.

SECOND EDITION,

REVISED AND ENLARGED.

PRINTED FOR THE NAVY DEPARTMENT OF THE UNITED STATES.

BRUSSELS.

LOUIS TRUYTS, PRINTER.

1862

Part of the following pages were originally written in English, having been destined to be inserted in an English military journal in order to rectify some erroneous statements on the Belgian metallic fuze for explosive projectiles. Circumstances having interfered with the execution of this purpose at the time, I was afterwards induced to extend my remarks on the use of the Shrapnel Shell in the late Crimean war, and relying on the indulgence of my readers, I have preferred leaving the whole in English, as the most important of my quotations are from works in that language.

Brussels, November 15th, 1858.

The first Edition of my historico-technical Sketch had a most flattering reception in the United States of America, and was so fortunate as to meet the approval of the Government.

Having been since honoured with an order for five hundred Copies from their Navy Department, through Captain Dahlgren, Chief of the Bureau of Ordnance and Hydrography, a new Edition has become necessary, and wishing to prove to the Government of the United States my high sense of the distinction thus conferred upon me, I have resolved to have this second Edition printed for their exclusive use, after careful revision, and with the addition of Appendix IV, entitled: "A Glance at the present state of the Shrapnel question in England"; — in the hope that this fuller development of the principles of gunnery I have advanced, may prove so much the more valuable to the

younger Officers of the U. S. Navy in preparing for the service of their great country.

My confidence in this result is strengthened by the abundant proofs of high valour and intelligence, which the Officers of the U. S. Navy, since its creation, have ever evinced; and by the high talent with which the Ordnance Department of this Navy is directed by Captain Dahlgren, whose ordnance pieces have been so successfully used in the present war.

The application of the Dahlgren Ordnance System in that war has afforded proof of an incontestable truth of the highest importance for all States, i. e. that any Artillery would deprive itself — apart from the economical view of the question, — of a great amount of destructive power, that should hastily put aside, as unworthy of further consideration, the use of smooth bored pieces whilst adopting that of rifled ones. This fact has been fully confirmed by the successful and brilliant results recently obtained in Shrapnel (Hail-Shell) fire from smooth bored brass field 12-Pounders, at the practice ground of Brasschaet, by the Royal Belgian Artillery, whose mastery of that kind of fire is universally and justly acknowledged.

With the permission of General H. Shelton Sanford Minister of the United States at the Court of Brussels,

I have the satisfaction to subjoin copies of the two following letters :

LÉGATION DES ÉTATS-UNIS.

Bruxelles, le 27 août 1862.

General,

I have the honor to enclose you herewith a letter from the Navy Department requesting the transmission of 500 copies of your valuable work on Shrapnel.

I am gratified to be able to communicate to you this evidence of the high appreciation with which you and your contributions to the Science of War are held by my Government, and I have the honor to be, General, with sentiments of high consideration,

Your Obedient Servant,
(Signed) H. S. SANFORD.

General BORMANN, etc., etc., etc.

Bureau of Ordnance Navy Department,
Washington, D. C.
29 July, 1862.

General,

I have the honor to inform you, that I am instructed by Captain Dahlgren, Chief of this Bureau, to request you to forward through the U. States Legation at Brussels; — (500) Five Hundred Copies of your valuable work on Shrapnel.

I am General
with high respect
Your ObSt.
(Signed) H. A. WISE, U. S. N.,
Assistant to Bureau.

General BORMANN, etc., etc., etc.
Brussels.

Brussels, October 8, 1862.

ERRATA AND MODIFICATIONS.

Page.	Line.	For.	Read.
61	3	"artifices"	fireworks.
95	17	"as largely so"	so largely as.
100	4 note	"hut"	but.
119	3 note	"obout"	about.
160	21	"Sachse"	Sachsse.
169	11	"M."	Mr.
172	15	"adressed"	addressed.
200	1 and 2	for "or on a coast, and on board ships",	

substitute : whenever the enemy is on board ship or effecting a landing on a sea coast.

I here subjoin the following report on an experiment made in England and published in *The Court Journal*, May 10, 1862, p. 437. Art. "Army and Navy".—received too late for insertion in the text.

" A series of artillery experiments, on a scale of unusual magnitnde, have " recently taken place at Shoebnryness. The object was to ascertain the " probable effect of ordinary field batteries of 12-pounder Armstrong guns " in resisting the landing of an invading force. For this purpose a large " number of floating targets representing boats were towed out to sea by a " steamer, and fired upon at various distances from 3,000 to 1,000 yards. " Five field batteries of Armstrong guns opened fire with shell from the " beach, and presented a magnificent spectacle. The accuracy with which " the shells burst, and their effect on the targets, were regarded with geue- " ral astonishment and admiration. Hardly a vestige of any of the targets " was left. It was agreed on all hands that not a man could have reached " the shore alive, and that the protection afforded by our present field " artillery is of the most satisfactory nature. The guns fired fifty rounds " apiece, and not the smallest accident occurred".

Supposing the application of fuzes of the best possible construction and quality, such a result could not possibly have been obtained by means of a concussion or a percussion fuze, but only by a *time fuze;* and what is true in the case of Armstrong guns, is equally true of any System of rifled guns.

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SHRAPNEL SHELL

IN ENGLAND AND IN BELGIUM,

WITH SOME REFLECTIONS ON THE USE OF THIS PROJECTILE IN THE LATE CRIMEAN WAR.

A HISTORICO-TECHNICAL SKETCH.

Introductory remarks on the object of the present Memoir.

§ 1. — The English were the first nation who, in modern times, employed the projectile, known in England more under the name of *spherical case-shot* than under that of *Shrapnel;* hence generally,— though erroneously, as we shall see hereafter, — its invention is believed to be of English origin. The English also have since the battle of Vimiera (1808), or during half a century, continued to make use of this projectile; meanwhile no other nation has seriously attempted to do the

same until within the last twenty-five years. These circumstances naturally led to the expectation, that certain improvements, which the projectile invented by General Shrapnel was judged by experienced officers still to want to render it fit for field service, would come from England rather than from any other country, but in this expectation the military world was deceived. Its latest most important improvements on the contrary, have been made on the Continent, where extended experiments from year to year prove the vast importance attached to the perfecting of this excellent projectile. And as it might be supposed that hardly any artillery in Europe would remain ignorant of this progress, great was the astonishment to see two mighty armies and navies, those of England and France, engaged in the last Russian war, apparently despising the aid of the destructive force which the projectile in question was able to afford, especially in this particular case.

Owing to this neglect not only were the allied armies deprived of an auxiliary force worthy of attention, but science also lost a valuable confir-

mation on a grand scale of the efficiency of Shrapnel fire; for, there are still many officers of all arms, who are and will remain incredulous as respects the importance of Shrapnel, as long as they have not yet seen this projectile subjected to the test of battle (*baptême du champ de bataille*) like that which the Russian war could have shown them. I, however, must declare myself against this sort of scepticism in such a case as that under consideration, because it then is rather dangerous, not for the officers alluded to, but for the government that bases its decisions on arguments of this nature in following their advice. Nobody will contradict the assertion, that in warlike operations the first application of a decisive measure, which the enemy is incapable of utilizing simultaneously, brings its assured reward, whereas science may wait for its disclosure till after the intended blow has been struck; — no such amount of proof is necessary and the least so for artillery officers.

Belgium, that comparatively small country with her but recently created artillery, having made the most laudable exertions for the rational solution of

many an important problem respecting ordnance service, has honourably distinguished herself in the prosecution of the Shrapnel question and is entitled, by virtue of extended and successful experiments, to a voice on this subject, which, at least, ought to have protected her regulations in this matter against disparaging statements; but an article published in Colburn's United Service Magazine for February 1854 : " *The Shrapnel" ;* shows the contrary.

This article misrepresents in its peremptory language the real stage in which the outbreak of the late Russian war found the Shrapnel question in England, and supplies, strangely enough, the want of reason for this language, by condemning *the metallic fuze* adopted in Belgium and which I, some twenty years ago (1835) proposed as *the basis* of an improved Shrapnel and shell system; I, therefore, think myself justified in founding the following considerations, in great part, on a portion of this article, and *so much the more* as it seems to present pretty nearly the opinion which, in 1852 prevailed in the *Ordnance Select Committee of Woolwich* on the subject in question. The portion here referred

to, is comprised in pages 165 to 170; — the other portion (pages 159 to 165) contains political discussions which I may pass over in silence.

Alleged state of the Shrapnel question in England and Belgium until 1854.

§ 2. — The anonymous author of this article — whom I henceforth will call, and *for the sake of brevity only,* my opponent, — reproaches the Royal English Artillery with having been somewhat indifferent to several military questions of the day, in consequence of which he asks. p. 165: " Why is " there so much complication in their ammunition, " round shot, shell, case shot, spherical case, etc.?" — He then gives some historical notices respecting General Shrapnel's shell and explains the component parts of this projectile; — he states that " on the " fuze igniting the charge within the shell in a cer- " tain given time rests the whole secret"; — he enumerates the qualities which he thinks this important part of the projectile ought to have; — he gives some details respecting the wooden fuze which General Shrapnel originally made use of for his shell; — he analyses two other fuzes, the Norwegian pasteboard and the Belgian metallic fuze; — he condemns this metallic fuze as completely " *use-*

less" and indicates numerous inconveniences, which, according to his own opinion and to that of some military writers, arise from its use;— he points out the principal difficulties the Royal Artillery has met with when applying General Shrapnel's original spherical case-shot, and concludes finally, p. 170 in the following terms: " These difficulties " have, however, now disappeared, and the shell " as invented by Shrapnel, and brought to perfec- " tion by Boxer, is now a most formidable pro- " jectile. Most simple in its construction, easily " fixed, and sure of accuracy in its bursting. Ar- " tillery can now dispense with common care, for " the Shrapnel can be regulated to burst any " distance from the muzzle; and thus they can go " into the field with simple solid shot, shells, and " Shrapnels."

It certainly was a meritorious deed—even as late as February 1854,— to remind the Royal English Artillery of the urgent necessity of improving their Shrapnel fire, as this kind of fire still might have been of immense advantage for the English troops who, seven months later, fought like heroes in the

bloody drama which began with the battle of Alma on the 20th. of September 1854 and ended with the fall of Sebastopol on the 8th. of September 1855. But for so essential a purpose, as *to strike a mighty, unforeseen blow* in that war, the ordinary means, hitherto employed by the Royal Artillery, were evidently insufficient, and it was indispensably necessary to apply a Shrapnel system founded on more suitable, mōre extended principles. So far, however the foresight of my opponent certainly did not go. I have even some reason to doubt whether he ever had an idea of what may be effected with Shrapnel fire when regulated on principles like those I have advanced, but it is evident that he, at least, felt the necessity of substituting something better for the original English Shrapnel system.

He decides this question in favour of Captain Boxer's Shrapnel system, and endeavours to gain the opinion of his readers in its favour. This is not surprising, as he appears to believe in the superiority of Boxer's system; neither can he be blamed for having restricted himself to the few general terms above cited from p. 170, which leave no

chance to the reader of forming his own opinion on the merits of Captain Boxer's system, nor for his having criticised other Shrapnel systems;— but I have some objections to make to the manner in which he has, on this occasion, made mention of the *Belgian metallic fuze.*

The details he gives of it are, in great part, taken from General von Decker's work : " *Die Shrapnels*" published at Berlin in 1842 and translated into French by MM. Terquem and Favé in 1847 (*). This work, indeed, contains a great number of passages respecting the metallic fuze in question, but most of them are incorrect or unfavourable to its adoption. My opponent unfortunately refers principally to these passages, and overlooks those which the candour of the two French authors had admitted into their translation, and finally he arbitrarily rejects the remarks I opposed, at the time, to MM. Terquem and Favé's opinion on the metallic fuze (**). I must add to this : 1st. that Gene-

(*) *Expériences sur les Shrapnels faites chez la plupart des puissances de l'Europe;* par Decker, traduit par Terquem et Favé. Paris, 1847.

(**) *Expériences sur les Shrapnels, nouveaux développements sur*

ral von Decker and another officer of the Royal Prussian Artillery, Lieutenant Schlieper, whose criticism the General fully approves, (see : Terquem and Favé, p. 10, n° IX and p. 287) were excessively hostile to the Belgian Shrapnel system, even before they had an exact knowledge of it ; 2d., that these two officers, without casting any doubt as to their vast knowledge in other branches of ordnance service, were not in every respect competent judges of Shrapnel fire when they wrote on this subject, as may be perceived in their own writings of the period from 1837 to 1842 (*) ; 3d., that the offi-

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les résultats obtenus en Belgique ; par Bormann. Paris, 1848 ; or *Journal des armes spéciales.* Paris, Décembre 1847, janvier et juin 1848.

(*) These two German authors not only unjustly criticised the Belgian experiments of 1835 on which I had reported in my " *Considérations sur le tir des obus à balles.* Paris, 1836," but also chose for their criticism a form, which can hardly be considered as *unobjectionable.* I was about to publish a reply to those passages of the work " Die Shrapnels" which render these experiments and my report suspicious, when General von Decker died suddenly at Mayence (26th. of June 1844). So sad an occurrence, of course, determined me to give up my plan and to leave it to time to prove that the experiments of the Belgian Artillery deserve as much confidence as the experiments made by the Prussian or any other good artillery. This object, indeed, is now fully attained, as several artilleries, who had the Belgian experiments in question repeated by able, but at the same time *impartial* officers, have found them confirmed in every respect — and so it will be in future. It is gratifying for me to mention here that this result proves how

cers of the French Artillery, generally speaking, may be numbered amongst the most obstinate antagonists of the Shrapnel projectile, and that Captain (now Colonel) Favé himself appears to have been scarcely an exception to this rule when he published Decker's work;— from these considerations it will be obvious that my opponent, so acting, easily made the best of his opinion.

By this proceeding he, perhaps, rendered an important service to the honourable Captain Boxer and at the right moment too, but rather a doubtful one to the military public and none to the Royal Artillery; for, the unsuspecting reader got by his article not only an imperfect and partly false opinion of the Shrapnel system which I had proposed, but also of Captain Boxer's; besides this the Royal Artillery was already better informed on both systems, as may be judged from the following statement.

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much clearer a view General du Vignau, also of the Prussian Artillery, took of this subject than General von Decker and other officers of artillery (Militair Literatur-Zeitung. Berlin, 1837, 6tes. Heft. November und December, p. 513 .

§ 3.—My opponent unjustly reproaches the Royal Artillery, p. 165, in the following words : " Let our " artillery not only gallop over commons to a con- " course of arrayed spectators, but let them endea- " vour to bring their branch of the service to per- " fection; "—for, two years before the publication of his article, the Board of ordnance had already in 1852 taken into serious consideration the necessity of improving their Shrapnel fire, in consequence of which decision and, as it appears, also at the special desire expressed by the highest authority in England, the Ordnance Select Committee at Woolwich was called in the same year, to examine several Shrapnel systems adopted in foreign countries, and amongst them particularly that which I had proposed in Belgium.

Adoption of a new Shrapnel system in England ; the Boxer fuze ; — the Boxer Shrapnel.

In the very same year, 1852, extensive experiments were made at Shoebury Ness on Captain Boxer's projectile, the results of which were then said to have been highly satisfactory; but notwithstanding this, the artillery which the English army and navy employed in 1854 and 1855 against Russia in the Crimea and in the Baltic were not

provided with Captain Boxer's Shrapnel, but only with the Boxer fuze, which, according to the standing ordnance regulations (*), was furnished for common howitzer and mortar shells, as well as for Shrapnel, this latter projectile being prepared after General Shrapnel's principle, that is to say, the bursting charge filling up the interstices of the bullets.

It was only in the following year, in 1855, either shortly before or soon after Captain Boxer's appointment to the direction of the Royal Laboratory at Woolwich, that his Shrapnel system was definitively adopted and that a certain number of Boxer's projectiles were prepared to be sent out to the Crimea; peace, however, was concluded in the meantime and the Boxer projectile remained in England.

How far, if at all, these facts are connected with the statement on the metallic fuze in my opponent's article, I am unable to explain. Some remarks would

(*) See : Captain J. H. Lefroy, F. R. S., Royal Artillery. *A Handbook for field service*. Woolwich, 1854.

have been made long since upon this criticism, but that Captain Boxer's system was not sufficiently known on the Continent. This deficiency having been supplied recently by Lt.-Colonel (now Colonel) Delobel of the Belgian Artillery in his work: *Revue de Technologie militaire* (*), I think it is important to state the plain truth in this matter.

This rich collection of interesting memoirs contains the description of several Shrapnel systems (p. 329 to 405, plates V to IX), in which Colonel Delobel also subjects *the new English Shrapnel* to a critical examination, especially in the subdivision : " Description du système Boxer".

It is not my present purpose to institute a complete parallel between the two Shrapnel systems in question. I shall here content myself with comparing a few passages taken from my opponents article and from works in which further information on the subject may be found.

(*) *Revue de Technologie militaire;* par L. Delobel, Lt.-Col. d'Artillerie, Directeur de l'Ecole de Pyrotechnie de Belgique. Tome II. 1857. Paris et Liége.

Considerations on the importance of the fuze for explosive projectiles.

§ 4. — Before entering, however, into this comparison I think it indispensable to state a few general points concerning the fire of explosive projectiles, as the reader who has never had an opportunity of witnessing a well-prepared fire of common and Shrapnel shells and of admiring their wonderful effect, might otherwise be astonished at the degree of importance which I attach to *the fuze.*

In firing such projectiles there are three conditions to fulfil :

1st. To determine the *bursting* of the projectile at *the precise point in its trajectory,* which will best suit the intended purpose;

2d. To regulate the flight of the projectile in order to *bring it* to this *desired point of explosion* or as near as possible to it; and

3d. To give constantly the best possible shape to the *sheaf of fire* (*gerbe de feu*) having its origin in the point of explosion, and being formed by the fragments of the projectile.

It is obvious that the first of these three conditions depends entirely on the fuze,—the two others on the projectile; but it is equally obvious that the first is the most important of all, as its successful application may render of less consequence any failure arising from that of the others, while the failure of the fuze renders the other conditions unattainable. The fuze therefore, is the *soul*, the *groundwork* of any system of explosive projectile, it is the criterion of the system; and indeed, what is a common shell fired with a fuze not fulfilling the first condition?—It is inferior to a solid ball, because the latter is cheaper and less dangerous to keep in store, and this applies more strictly to a Shrapnel. The untimely explosion of projectiles may accidentally render some service, but in cases like those under consideration, we never ought to rely for efficiency on accidental occurrences.

The fuze, insignificant in appearance, long misapplied and still neglected in the ordnance service of several countries, constitutes, as I have stated, the principal element in the projectile, the perfection of which may assure to artillery an importance

which this arm hitherto has not attained, the glorious deeds of the Royal British Artillery in the Crimea not excepted.

Considering, as I have shown already in a private communication to my friends in 1854, (*) : 1st. That artillery, at present, possesses no other means of developing so *powerful a destructive force* as that which may be obtained in acquiring perfect mastery in the fire of explosive projectiles; that the *fuze* alone furnishes the means of approaching as near as possible to this desired perfection; that this conclusion is nowise affected in the application of *ordnance pieces* and *explosive projectiles* what ever be their kind, construction, or calibre known at present or that may be invented in future— (be they guns, howitzers, mortars with smooth or rifled bore; Shrapnels, shells, bombs, elongated shells, shells fixed to war-rockets or destined to be thrown with the hand of man); — considering
2d. That artillery will so much the more com-

(*) *Notes* on Colonel Delobel's Memoir : " Nouveau système de Shrapnels de l'Artillerie néerlandaise; " one of the memoirs in his Revue de techn. milit. T. I. 1854.

pletely fulfil their important mission, as the *means of destruction* at their disposal are more efficacious and numerous;

3d. That a government acts not only in the interest of its own nation, but in that of mankind in supplying its army and navy with weapons fitted to develope the *greatest possible destructive force*(*);— on all these grounds, it must be admitted, that the principle of this *great power of destruction* is concentrated in the simple and modest frame of a fuze, and consequently that this component part of the projectile merits special attention. And, besides this, the solution of the fuze question is most difficult and delicate on account of the violence of the propelling power (*force motrice*) acting on the projectile in the bore of the piece.

The old and the new principle of fuze.

§ 5.—Of the three existing species of fuzes, viz : time-, concussion- and percussion-fuzes; *time-fuzes* are the most important not only for land, but also for sea service and are the only kind here under consideration (**).

(*) *Expériences sur les Shrapnels.* Par Bormann. Paris, 1848, p. 62.

(**) See : *A treatise on naval gunnery.* By General Sir Howard

Time-fuzes may be divided into two classes :
1st. one consisting of a column of composition driven and consumed in the direction of its length and penetrating into the interior space of the shell, — constituting *the old principle;*
2d. the other consisting of a layer of composition consumed transversely to its stratification und developing its whole length on the outer surface of the shell, — constituting *the new principle.*

Douglas, Bart. 4th. edition. London, 1855. — Page 241. — Explanation wherein consists the difference between the terms "concussion" and "percussion" applied to fuzes and shells. Page 625. — Statement of the damage sustained by the combined fleets (English and French) and caused chiefly by the Russian shells, which were fitted with time-fuzes, to which is joined the following remark : "The author learns from " letters written by a naval officer of high rank, and a distinguished " artillery officer, who were present in the action on board a line-of- " battle-ship, that the observations contained in Art. 328 p. 338 on the " severe effects of shell firing with time-fuzed shells upon ships, " were remarkably verified in the attack of the Russian forts at Sebas- " topol". And these observations are :

" While ships are approaching, under fire of the heavy ordnance " with which coast batteries should ever be armed, a few well-directed " shells, having time-fuzes, thrown in at suitable distances, to act against " the whole expanse of a ship—masts, sails, and body—can scarcely " fail to produce very severe dismantling effects, which will very " much interfere with, and impede the operations they have yet to exe- " cute, before they can open their fire with any safety or effect; and " Shrapnel shells well applied during the operation of furling sails, " would be extremely deadly to the crowds of hands then aloft".

Captain Boxer's fuze, as well as the old common wooden fuze, is founded on the old, the Belgian metallic fuze on the new, principle.

The Belgian metallic fuze unjustly criticised in England.

§ 6.—Speaking of the latter fuze, my opponent states, p. 167 : "The fuze invented by Bormann, a " Belgian artillery officer, is rather a complicated " one," and p. 169 : "We now come to the inconve- " niences arising from the use of the Bormann " fuze; and having seen it practised, we must cor- " dially agree with MM. Terquem and Favé, in spite " of the explanations given by Bormann, in his " "Expériences sur les Shrapnels" published 1848. " Other fuzes may be bad ones, as he states, but " that does not improve his. The fuze, as a fuze, " is a very ingenious, and much to be commended " inspiration. But as a fuze to fire Shrapnels in " the hurry and flurry of an action, it is useless. " It requires great coolness, dexterity, and a " good knowledge of calculation to be able to " prepare them for firing at respective distances, " and nothing which is not as simple as pos- " sible, should ever be put into the hands of sol- " diers."

Refutation of this critic by quotations from competent military authors.

§ 7.—In the French "*Mémorial de l'Artillerie,*" nº V, Chapter *Obus à balles*, it was already asserted that the metallic fuze was too complicated. The late Major Jacques, who was a distinguished officer of the French Artillery, opposes to this opinion (Terquem and Favé, p. 290) the following remark :

" As to the reproach of complexity brought against
" the fuze, it appears unjust, if we consider that its
" complexity exists only in the construction of
" the mould in which it is cast; since the number
" of pieces composing a lathe on which the wooden
" case of the common fuze is turned, are not com-
" monly considered as a defect in this fuze."

The *wooden case* of the Boxer fuze (*Revue*, T. II. Pl. VI), having three longitudinal channels, a transverse one and nine little holes in two longitudinally placed rows, and this fuze requiring moreover a second *case of brass* (*ampoulette*) with two screw threads, two metallic disks and a metallic cap (*chapeau*) with one screw thread; I think the simpler construction and consequently also the simpler, easier fabrication, is rather on the side of the metallic fuze, than on that of the Boxer fuze.

The following extracts from Colonel Delobel's and Captain Dahlgren's valuable works (*), to which I particularly refer in order to show the state of the metallic fuze at the period in question (1854) in two very different countries, will prove that the metallic fuze really possesses, in addition to the simpleness in fabrication, some other good qualities which Captain Boxer's has not.

Colonel Delobel (*Revue*, I, 1854, p. 80), alluding to a very interesting monograph on Shrapnel fuzes published in 1849 by Captain Martin de Brettes, of the French Artillery, and in which this officer gives the preference to the Splingard fuze (*Revue*, I. Pl. 1, fig. 1), states : "It is possible that M. Martin de

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(*) See : Note A. and

Revue de technologie militaire. Tome I.—1854 and Tome II.—1857 already cited; as well as

Boat armament of the U. S. Navy. Designed by and executed under the direction of J. A. Dahlgren, commander U. S. N. in charge of the ordnance department U. S. Navy yard, Washington, D. C. Second edition. Philadelphia, 1856. (Dahlgren. *System of armament for boats*. Philadelphia, 1852, being the first edition of " Boat armament "). And

Shells and Shell-guns. By J. A. Dahlgren, commander in charge of experimental ordnance department, Navy yard, Washington, Philadelphia, 1856.

" Brettes would have modified his opinion in this
" respect, if he had been able to draw from better
" sources than he could then do,—for it (the fuze)
" is still a little state secret,—his information res-
" pecting the metallic fuze, Bormann system, which
" the Belgian Artillery has definitively adopted
" after having yearly experimented on and im-
" proved it, for eighteen years; and especially if
" this technologist had known that this fuze, so
" ill appreciated abroad because it was there al-
" ways imperfectly known and awkwardly coun-
" terfeited, has now attained so high a degree of
" perfection in the double respect of its fabrication
" and of its mode of fixing it to the projectile (*),
" that it has been able of late, to undergo with com-
" plete success an ordeal (*épreuve à outrance*) of
" which, we believe no other example can be cited.
" We know in fact, and to a certainty, that by
" order of a commission of experiments (in 1852 on
" the polygon of Brasschaet, near Antwerp), seve-

(*) Viz. by "*sertissure*" or setting, a simple, ingenious proceeding invented by Colonel Delobel, in order to avoid *screw threads* in the fuze hole of the shell.

" ral series of Shrapnels were fired with *fuzes*
" *regulated for bursting*, which projectiles had
" already been fired previously with *the same*
" *fuzes not regulated;* and that the results of this
" second fire have proved, most evidently (what
" many Belgian artillery officers themselves had
" doubted up to that moment), that these fuzes
" resist perfectly, without spoiling or detaching
" themselves, all the shocks which the projectile
" receives whether in the bore of the piece or in
" accidental ricochets on the ground. And still
" farther in order better to ascertain this last point,
" many Shrapnels, fired at first "*au tir roulant*"
" that is the shot rolling on the ground with their
" fuzes *not regulated,* and then fired a second time
" *with the same fuzes duly regulated*, all resisted
" this unheard of proof and farther burst with
" perfect regularity."

And recently in 1857, *Revue,* II, p. 351, Chapter "*Nouveaux Shrapnels autrichiens*"; in speaking of the Belgian fuze he says : "As we have had
" occasion to state, thanks to the numerous im-
" provements which have been made since 1850,

" our Shrapnel fuze, Bormann system, leaves no-
" thing to wish for in what concerns the perfect re-
" gularity of its combustion, its preservation in ma-
" gazine, its mode of fixing it to the projectile and
" its insensibility to the shocks which the projectile
" receives in the bore of the piece or in ricocheting
" on the ground (*)."

To this, however, Colonel Delobel adds the following *objection :*

" But it is not the same as to the *regulation* (*ré-*
" *glage*) of this fuze."—

On this subject our opinions differ, as will be more fully explained hereafter in § 8.

The advantages which Captain Dahlgren attributes to the metallic fuze are recapitulated as follows :

(*) In Belgium Shrapnel is fired from the long 12-pdr fieldgun with two kilogrammes of powder or a little more than $\frac{1}{8}$ of the weight of solid shot. This charge is stronger than those employed in other countries for the same purpose and stronger, indeed, than necessary not only for Shrapnel, but even for solid shot.

(*Boat armament*, p. 90).—1st. "The composition " being condensed by a single pressure of the " machine, and the combustion occurring trans- " versely to the stratification of the mass, offers " better conditions for uniformity in duration than " the common fuze, which is formed of layers " compressed successively one above the other, " and consumed in the same manner."

2d. "The whole error of fabrication, whatever " it may be, is only experienced when the fuze is " opened at its extreme duration,—at all inferior " times it is reduced proportionally, so that an ex- " cess or deficiency of two or three tenths of a " second at the full extent of the duration, would be " limited to $\frac{4}{100}$ths or $\frac{6}{100}$ths of a second if the fuze " were cut to one second of time, etc., etc. On the " other hand, by using a separate fuze for each time, " the whole error of process is incurred in each."

3d. "Certainty of ignition and communicating the " flame to the charge of the Shrapnel."

4th. "Safety against external accident from water and " from fire, which is certainly of great importance, " particularly when it is considered that boat opera- " tions afford but little protection against either."

5th. "Security against explosion, in the bore of " the piece, which is the most detrimental of all " accidents to which Shrapnel or other explosive " projectiles are subject; for the round is thus " lost, and the bore of the gun more or less dis- " figured by it."

6th. "Greater convenience, because Shrapnel is " issued complete and ready for instant use, which " is not practicable with the fuzes now used."

And p. 97, in reporting on a Shrapnel practice witnessed by His Excellency the President of the United States : "Of the fuze itself it is proper to " say, that is arrangement its at once original and " scientific. For 200 years we have been treading " so closely in the footsteps of precedent that the " ordinary time-fuzes of 1855 scarcely differ in the " principle of applying a composition to graduate " and convey flame to the charge of a shell, from " that in vogue at Dole, in 1632 (*). That of Co- " lonel Bormann is a felicitous conception; it evin-

(*) Le siége de Dôle. *Études sur le passé et l'avenir de l'Artillerie;* par Louis-Napoléon Bonaparte, Président de la république. Tome deuxième. Paris, 1851, page 334.

" ces a sound appreciation of the real difficulties
" involved in the problem, and exhibits the prin-
" ciple of solution in a masterly manner."

Shells and shell-guns. Chapter: Fuzes, p. 151.
" — The use of this excellent and ingenious fuze
" has, so far, been confined to the shells and
" Shrapnel of light artillery. What objections
" may arise to its use in heavy calibres, has not
" yet been ascertained by actual practice, though
" its great regularity and convenience, may well
" render it exceedingly desirable for the Navy." —
Which observation may be completed by the remark, that in Belgium Shrapnels have been successfully fired with the metallic fuze: from Paixhans' shell-guns of 0^m22 and 0^m27 (9 and nearly 11 inches English); from Belgian 60- and 120-pounder shell-guns (0^m20 and 0^m25 or 8 and 10 inches English); and, finally, from à Belgian 48-pounder gun (nearly of $7\frac{1}{2}$ inches English) with 8 kilogrammes of powder ($17\frac{lb}{100}$ English) or nearly one third of the weight of the projectile, the 48-pounder Shrapnel weighing in this case $22^k.61$ or $50\frac{lb}{100}$ English.

The metallic fuze requires no knowledge of calculation, if the tangent-sight (*hausse*, the instrument) adopted, is founded on rational principles as shown p. 9, in my pamphlet "*Expériences sur les Shrapnels*, 1848." This operation then requires no more calculation, coolness or dexterity than that of laying a gun. Three series, *inseparable* from each other, are engraved on the instrument; viz :

1st. the tangents of the angles of elevation belonging to an adopted series of distances or ranges; these tangents are marked in real size;

2d. the ranges expressed in numbers, at the upper end of the tangents; and

3d. the times of flight (half-seconds, in Belgium called *temps*) giving the duration of the fuze, equally expressed in numbers and joined to the ranges.

And on the fuze also, a scale of times (*l'échelle de temps*) is engraved, which corresponds with the series of times No. 3 on the tangent sight.

In action the officer directing the fire commands

the distance or range; the pointing gunner, pushing the visor of the tangent-sight on the transverse liue, which is indicated by the commanded distance, finds on the very same line the corresponding time of duration to give to the fuze, which time he, in all cases, has to pronounce with a loud, intelligible voice. He himself, therefore, or an other servant charged to regulate the fuze, has merely to choose the corresponding point on the *time-scale* of the fuze, to place the cutting tool on it and to lay bare the fusing composition.

This operation is executed with the hand either by means of a chisel (*gouge*) as done in Belgium and several German States, or by means of a sort of scissars (*pince*) as done in Sweden and in the United States, and, amongst these latter instruments that especially which is used in the U. S. Navy, thanks to the ingenuity of Captain Dahlgren, I believe, is said to render the regulation of the fuze so exceedingly easy, that nothing more could be wished for in this respect.

The best instructed Belgian gunners have already practised this regulation of the fuze, on the polygon

of Brasschaet, in the surprisingly short space of time of from 2 ½ to 7 seconds, the less exercised men in 15; meanwhile the operation of laying the gun required under the very same circumstances, from 13 to 30 seconds. Therefore, an additional extra allowance for the execution of each of these two operations in action may be granted without going beyond reasonable limits. Conditions for the fire on the field of battle in general, have changed so much that, at present, even a much slower rate than was formerly deemed necessary, is adviseable.

The Belgian metallic fuze modified by CaptainBreithaupt and by Colonel Delobel.

§ 8. — Some officers, however, still see difficulties in cutting the *metallic cover* of the fusing composition and expect to obviate them by the use of a *moveable metallic covering and regulating disk,* (*disque obturateur et de réglage*) which Captain Breithaupt of the Hessian Artillery has invented for this purpose and which affords a somewhat simpler process for regulating the fuze (*).

(*) *Militärische Zeitung* published at Vienna. No. 11 et 12, February 6th 1856. Article : Der Feld-Artillerie-Zünder des Kurhessischen Artillerie Hauptmann Breithaupt. And
Archiv für die Offiziere der Königl. Preuss. Artillerie- und Ingenieur-

Colonel Delobel also is of this opinion, and proposes (*Revue,* II, p. 361. Pl. V), a modification of the fuze according to this regulating principle. The objections he makes, on this occasion, to the Belgian fuze, require notice here on account of the position this officer occupied as Director of the Belgian "École de Pyrotechnie" when he wrote. These objections are :

Revue, II, p. 349 :—"The weak side of this fuze " as of all those on the Bormann principle, is the " difficulty of regulating it promptly and exactly " on the field of battle, amidst a thick cloud of " smoke and especially during the night. We shall " see farther on that Captain Breithaupt has found " means to obviate, as far as possible, this capital " deficiency of the Belgian fuze".

And *Revue,* II, p. 352 :—1st. "On the field of " battle it is much to be feared that the regulating " gunner, agitated by the battle and blinded by " the smoke of powder might want the time, the

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Corps, Berlin, 42ter Band, 2tes Heft 1857. Der Breithauptsche Zünder, etc. (By General du Vignau.)

" coolness and the skill necessary for rightly regu-
" lating the fuze; that he might cut it incompletely
" or perform that operation at some other divi-
" sion of the scale than that required for the dis-
" tance at which the firing takes place; and that
" the result might be that the Shrapnel will not
" burst at all or will do so too soon or too late,
" sometimes even in the very bore of the piece or
" so near its muzzle, that the fragments might
" become dangerous for the friendly troops, posted
" sideways in advance of the battery".

2d. "To perform this regulation from 40 to 60
" seconds are necessary, often even more; and that
" whether use be made of gouges (*gouges*), parers
" (*boutoirs*), punch (*emporte-pièce*), or of so many
" other analogous tools which have been tried in
" different artilleries without excepting the scis-
" sars with a regulating dial (*la pince à cadran ré-
" gulateur*) invented by the Swedish General Baron
" de Wrède."

3d. "Every fuze, which has been regulated for a
" certain distance, indeed, may serve again after
" new regulation for a *shorter* distance, but not for
" a *longer* than that corresponding with the first

" regulation. Now, does it not often happen in war,
" that the distance of the mark changes during
" the preparation for charging a piece, or that it
" becomes needful to cease firing at the moment
" when this preparation is in course of execution ?
" It is then easy to conceive the serious inconve-
" niences which may result in such cases from the
" mode of regulation in question."

4th. "The fuzes being set (*étant serties*) in the
" fuze-hole of the Shrapnels, they can neither be
" removed without destroying them, nor without
" spoiling more or less the groove made for the
" setting (*sertissure*); without taking into account,
" that the unloading is an operation slow, difficult
" and even dangerous, if not executed with a par-
" ticular tool."

5th. "In order to exercise the gunners in the re-
" gulation of the fuze, it is necessary to send, each
" year, to the regiments a certain number of
" fuzes; this would cause, it may be conceived, a
" considerable expense, if the number of fuzes
" thus applied, was so great that the majority of
" the gunners might be sufficiently exercised in
" this very delicate operation, which every gunner

" may possibly be called on to perform in the " eventualities of war."

The majority of these objections being already disposed of by my preceding citations, and the Belgian Artillery executing the Shrapnel fire *by day* and *by night* as well as it ever may be required, I confine myself here to a few remarks :

As to the prompt and exact regulation of the fuze, there is hardly any thing gained by the Breithaupt principle, even in the night; I readily admit, however, that the power of employing a once regulated fuze for a *greater* distance by a *second* regulation, is a real advantage of the Breithaupt principle, though a much less important one, than that which it, as well as the Belgian fuze, offers in a *second* regulation for a *smaller* distance. The groove made for *setting* may be easily constructed more conveniently than at present.—The capability of unscrewing the Breithaupt fuze from the projectile without destroying it entirely, can be also given to the Belgian fuze, but, I think, this is a doubtful gain; for little or no confidence can be placed in such removed fuzes, as they will be

always more or less damaged by this operation, especially if they have been fixed for some time to the projectile.—The expenditure for Belgian fuzes for the instruction of the gunners, is not so considerable as it may appear, first on account of the low price of the fuze, and secondly on account of the remaining metal which may be used for other purposes; and besides this, other expedients may be easily found by which the number of these fuzes will be considerably reduced.—The danger of removing a Belgian metallic fuze from a projectile is not greater than that in unscrewing the Breithaupt fuze if proper care be taken, but then it is a little more troublesome and the bursting charge is lost.

It, therefore, yet remains to be seen, whether in rendering the regulating operation *a little easier* by this principle other good qualities of the Belgian fuze are not sacrificed, so that what is gained on the one side may be ultimately counterbalanced by a loss, perhaps of superior importance, on the other.

There are still two inconveniences of the present

pattern of the Belgian metallic fuze which Colonel Delobel does not mention : 1st., the time-scale on it is too darkly coloured; 2d., if, in firing during heavy rains, the regulating gunner is not careful to cover the fuze, the small surface of the composition laid bare may be moistened and failures of ignition be the consequence. The first, no doubt, may be easily remedied, the second considerably diminished, if not entirely avoided. A disk of waterproof cloth attached to the strap of the projectile so that it may be lifted up in regulating the fuze will offer some temporary shelter against the rain; a change in the position of the surface of the time-scale, a more effective one. But the inconvenience arising from the influence of moisture exists in a much higher degree in the present pattern of the Breithaupt fuze, as water, in heavy rains, may find access to the fusing composition at any point of the perimeter of the regulating disk, and, the fuze not being air-tight, is constantly exposed to the influence of damp air, both in course of fabrication and whilst lying in store, which is not the case with the Belgian fuze.

The anonymous but well informed author of an

article in the journal "*Moniteur de l'armée belge*" on General du Vignau's already mentioned memoir concerning the Breithaupt fuze, expresses the opinion, which now prevails in the Belgian Artillery on this fuze so correctly, that I cannot help citing it in a subjoined note (*) as a piece of interesting information. Admitting that all inconveniences of the Breithaupt fuze designated in this article as well as in the foregoing lines prove to be insignificant in comparison to the greater easiness obtained in the regulating operation ; admitting that the higher price of the fuze be no objection ;— yet the difficulty of applying this fuze to explosive projectiles of all kinds and calibres and especially of the greater calibres, seems still to assure the preference to the *simpler Belgian fuze with fixed metallic cover* ("mit starrer Metal-Decke", as General du Vignau says), until further experiments prove the contrary, because this latter fuze is not, like the Breithaupt fuze, strictly confined to the circular form; the line, measuring the shortest way the fire

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(*) Note B.

has to run through in consuming its prism of composition, may be indifferently a curved or a straight line of any length, which, in some particular cases as for shells fired from rifled guns and with war-rockets, may be a matter of no small importance.

I think I have no need to state here how much I feel gratified in seeing distinguished officers declaring themselves for the new principle of fuze exposed in § 5, and I shall be still more gratified, if such officers lend their experience and genius to improve its application. Captain Breithaupt, Colonel Delobel and General du Vignau, as I gather from their valuable and friendly communications, are already convinced of this truth and will, I hope, not deem me inordinately tenacious, if I am still compelled to withhold my unrestricted approval of the Breithaupt regulating principle. I sincerely wish its full success and shall be glad to find two modes of regulation, equally efficient, either of which may be advantageously used.

Such a favourable result, however, will not be attainable without sensibly modifying the *case of*

the fuze proposed by Captain Breithaupt or by Colonel Delobel. This modification, I think, ought to have in view :

1st., to protect the fuzing composition and the priming (*amorce*) completely against all influence of moisture, water and sparks;

2d, to avoid the loosening and the tightening of a screw; and

3d., to have the priming chamber uncapped and the quickmatch, contained in it, ignited by the charge of the piece (see *Expériences sur les Shrapnels*, 1848, p. 21);—including suitable dispositions to ensure, as far as possible, the mobility of the regulating disk during a long lapse of time, as required for fuzes left for years in store or fixed to projectiles.

Not considering the difficulty of applying this fuze to shells of the greater calibres, these modifications, which I think practicable, would, if successfully effected, leave the following difference between the two compared patterns :

A. *The metallic fuze with fixed time-scale* — being of moderate price; requiring a certain skill in cutting it open, but which any person with or-

dinary readiness and perception may soon acquire; being once regulated, may be regulated a second time but only for a *shorter* distance, and being perfectly air and water-tight to the moment in which it is cut open;

B. *The metallic fuze with moveable regulating disk*—being of a higher price (perhaps triple or fourfold); requiring still less skill to regulate it, as this movement will consist simply in turning the disk round its pivot; being once regulated, may be regulated a second time for a *greater* as well as for a *shorter* distance; and being completely air and water-tight even in firing during heavy rains,—constituting, so to speak, the *beau idéal* of a time-fuze.

It is obvious that of these two fuzes, A and B, the former less perfectly agrees with the principle, which I always have had in view in my propositions, viz : *to reduce the duty of the serving gunners on the field of battle to its simplest degree possible*;—but that different motives may yet exist, to make it preferable to the latter (*). Proposi-

(*) If the fuze (B) be desirable for firing common and Shrapnel

tions for modifying the external shape of the fuze not being in their place here, I have contented myself with indicating them; the essential point for me is, to establish the fact, that the metallic fuze, all its modifications and also that operated by Breithaupt included, has found a favourable reception in many countries.

Facts disproving the alleged uselessmess of the metallic fuze in action.

§ 9. — As to the alleged uselessness of the metallic fuze *"as a fuze to fire Shrapnels in the hurry and flurry of an action,"* it is contradicted by experience in the field, if the foregoing explanations and the comparative Table (*) I annex here for this particular purpose, should not be sufficient to lead to this conviction.

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shells from field *guns* and *howitzers*; the fuze (A), is sufficient for the fire of bombs from *mortars*, for which the fuze (B), as well as the present Breithaupt pattern, would rather be a costly luxury, than an absolute necessity. — The main object, therefore, which General du Vignau in his memoir intends to attain with the Breithaupt principle, that is to say the general solution of the question of the fire of explosive projectiles (die allgemeine Lösung der Frage des Hohlgeschossfeuers), is already fully attained with the Belgian fuze, at least, for those states which prefer or are obliged to prefer, an insignificant augmentation of labour to a notable one in expense; the amount of both may be judged of from § 8, § 9 and Note C.

(*) Note C.

The Hanoverian Artillery, for instance, applied the fuze mentioned in note A, with great success in the campaign of Schlesswig in 1848 and 1849. The affairs in the Sundewitt on May 28th and 29th, June 5th 1848 and on April 6th 1849, in particular are cited in proof of this. In 1848 a troop of Horse Artillery fired 6-pounder Shrapnels; a field battery 9-pounder ones; in 1849 Shrapnels were fired from four field batteries, one of which was composed of 24-pounder howitzers, two of 6-pounder and one of 9-pounder guns. One of these 9-pounder batteries alone fired 70 Shrapnels on the 5th of June. The officers of the Hanoverian Artillery who took part in these brilliant engagements, were much satisfied with their Shrapnel in general and with their metallic fuze in particular, as their commander in chief was himself kind enough to assure me. A farther confirmation of this statement is, that the Hanoverian Artillery still makes use of the very same fuze (*). Colonel Delobel, therefore, is rather in the wrong in pretending (*Revue*, II, p. 331),

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(*) Schmoelzl. *Ergänzungs-Waffenlehre.* 2te Auflage. München, 1857. § 318.

that these facts have been merely rare exceptions.

As another proof of the applicability of the metallic fuze, I may instance the Shrapnel and shell fire employed April 4th 1854 by a detachment of the U. S. Ship *Plymouth*, against a body of Chinese Imperialists encamped about Shanghai. I mention this fact and join here the official account in its full length (*), because officers and men of the Royal British Navy co-operated in the action in question, and because nobody,—remembering the intelligent and eminent services which the Royal British Naval Brigade rendered to the allied armies when acting as land artillery at the late siege of Sebastopol,—can or will refuse to officers of this highly distinguished corps, the acknowledgment of their being competent judges in this particular case.

The *Plymouth* carried Dahlgren Boat-howitzers fitted out with Shrapnel, shell and canister. The Shrapnel and the shell were provided with the

(*) Note. D.

metallic fuze, American pattern, mentioned in note A.

On failures in practice with the metallic fuze.

§ 10.—If British officers and my opponent have seen failures in the practice with the Belgian metallic fuze, they perhaps have had no interest in enquiring for the internal cause of them. In Belgium the very first experiments on this fuze succeeded beyond all expectation; then followed a period in which frequent failures took place, but the practical Belgian Artillery soon discovered the real cause of this defect and removed it. Since that time, officers of the British Artillery have visited the practice ground of Brasschaet,—the last time I think in 1856,—and I may hope that these officers will occasionally have seen a better Shrapnel practice than that of which my opponent speaks.

Similar circumstances have occurred in other countries. Some governments asked for official communication of the Belgian Shrapnel system; the Belgian war office, admitting equitable principles of reciprocity in these sort of relations with foreign

countries, granted it most willingly and in the most noble manner. In none of these countries, however, did the experiments made with the metallic fuze (the essential part of the system) give satisfactory results. Meanwhile just the contrary, —with one exception as far as I know,—happened in several other countries as well as in two of the former referred to, in which, at a later period, the Belgian fuze, insignificantly modified in its case, was commercially imported by persons, who in Belgium had contrived to obtain by some means or other, a knowledge of its interior arrangement without the permission of the Government.

The afore noted exception took place in Holland, where extended experiments, *during six consecutive years* from 1847 to 1852 included, entirely failed with the *very same pattern* of the metallic fuze with which the Hanoverian and other Artilleries completely succeeded (*). It was necessary

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(*) Captain Siemens (see Note A) furnished the metallic fuze to the Dutch Artillery.— For the failure in Holland see Delobel, *Revue*, I. p. 83; for the success in other countries, Schmoelzl. *Ergänzungs-Waffenlehre.* München, 1857, and Schuberg. *Handbnch der Artillerie-Wissenschaft.* Karlsruhe, 1856.

to speak of these particular circumstances in order to prove, that, where the metallic fuze is définitively adopted, its adoption can only have been determined by its inherent qualities, and that its rejection in the few countries in which it has been equally subjected to experiments, may have had other reasons, *foreign* to the merits of the fuze.

There are Artilleries of which the commanding officers may have reason to believe their men unable to make use of the metallic fuze on account of its supposed complicated character,—this would seem to be the case with the French Artillery (*); but this supposition is inadmissible in reference to the men of the Royal British Artillery, who, on the field of battle have already overcome greater difficulties of this kind in making use of General Shrapnel's original fuze and more recently, in the Crimea, of Captain Boxer's.

Remarks on the interior construction of a shell intended for Shrapnel fire and on the manner of loading it. —

§ 11. The inner construction of the shell as well as the mode of transforming it into a Shrapnel,

(*) Delobel. *Revue*, II, p. 360, 361 et 395.

has a certain influence on the final result of the Shrapnel fire, as mentioned in § 4. In regard to these two points also, the new English Shrapnel is inferior to the Belgian.

Classification of Shrapnel shells in use without reference to fuze.

Captain Boxer in his shell separates the bursting charge from the bullets by a wrought iron *diaphragm* in form of a *calotte* (*), fixed in its position by casting the shell over a core, in which it has been previously placed, as was formerly done in Germany with the circular diaphragm (*Sprengboden*) of incendiary bombs (**); a double swelling of iron (*boudin*) is given nearly in the middle of the inner space of the shell in order to fix the diaphragm, and besides this, the part of the shell opposite the fuze-hole, is reinforced or thicker in iron than the other part of the shell, probably with a view to place the centre of gravity of the whole system in this hemisphere. But this increase of thickness, the swelling and the vaultshaped dia-

(*) See Delobel. *Revue*, II. Planche VI. *Section of the Boxer shell*, p. 380.

(**) Schuberg. *Handbuch*, p. 104; and Terquem and Favé, p. 38. § 34, fig. 2 H.

phragm are sufficient to determine the shell's breaking first at its thinner, weaker part which surrounds the fuze, and consequently causing this part to be thrown on one side, and the thicker stronger part with the bullets, on the other; an effect, the irregularity of which is not likely to be entirely prevented by the shallow channels (*gouttières*) which Captain Boxer has practised on the inner surface of the reinforced hemisphere of his shell, evidently for the purpose of leading the inflamed powder gas round the bullets and creating in these channels less resistance for bursting.

Remembering now : that a *rotary* motion is imparted to this projectile by virtue of its eccentricity, which motion continues during its flight; that this rotary motion cannot be avoided, but only governed so far as to keep it in or nearly in a given plane, the direction of which is given by the axis of the bore of the piece, its position in reference to the horizon, however, being determined by the position which the centre of gravity of the eccentric projectile primitively occupied in the piece;— it will be easily perceived, that, even in the most favourable disposition, viz : if the rotary motion is produced

in the vertical plane (*plan de tir*), the effect of the fire will be rather different from one fire to another in *identical trajectories* according to the accidental position which the reinforced part of the shell occupies at the moment of explosion in respect to the object aimed at, that is to say, the greater part of the fragments of the projectile may then touch the ground before reaching this object, may pass over it, or may take an intermediate direction (*). The Belgian Shrapnel being a common shell of equal thickness of iron in which bullets and bursting charge are commingled (**), analogous causes of irregularity are partly weakened and partly avoided; hence the results

(*) For minuter explanation respecting the *rotary motion* and the different trajectories of an *eccentric projectile*, see my pamphlet " *Expériences sur les Shrapnels.* Paris, 1848. Tab. 2, and the "*Notice his-* " *torique* sur la partie de la balistique qui se rapporte aux phénomènes " de la *rotation*", which I furnished to *Revue*, I, 1854; but as to the shape of the *sheaf*, formed by the trajectories of the fragments of exploded shells and Shrapnels, my : " *Considérations et expériences sur* " *le tir des obus à balles* ". Paris, 1836; or "*Journal des armes spéciales*". Paris, 1836. Septembre et Octobre.

(**) Shrapnels of inferior calibres to that of 24-pound, have a shell reinforced at the fuze-hole and similar to the Baden shell (*Revue*, II, Pl. V), but simpler, as its fuze-hole has neither screw threads nor iron or brass plate called in Colonel Delobel's drawing " *Obturateur de la table de l'œil*". Shrapnels of 24-pound and of superior calibres have a shell, the interior space of which is perfectly spherical.

obtained with this simple projectile must approach much nearer the intended identity of effect, than those resulting from the fire of a complicated Shrapnel like that under consideration. And, indeed, from the above given reasons, some of the Shrapnels at present in use, may be ranged as follows, according as their construction more and more deviates from the principles which I think ought to be adopted for their inner shape and arrangement *without reference to the fuze:*

A.—Shrapnel. Bursting charge commingled with bullets:

a.) — General Shrapnel's original shell modified,.....the *Belgian Shrapnel,* as I proposed it.

b.) — General Shrapnel's original shell,...the *old English Shrapnel,* as proposed by General Shrapnel.

B.— Shrapnel. Bursting charge separated from bullets:

a.) Bursting charge in aspherical chamber, placed in the center of the mass of bullets,..... (*).

(*) Proposed in Sweden. See Major Blesson's treatise on fortifica-

b.) Bursting charge in a cylindrical space which runs diametrically through the interior sphere of the shell:

1.) Interstices of bullets filled up with charcoal dust,.....the *Hessian Shrapnel*, as proposed by Captain Breithaupt (*).

2.) Interstices of bullets filled up with solidified sulphur,.....the *Hanoverian Shrapnel*, as proposed by Captain Siemens.

c.) Bursting charge placed on one side, bullets on the other of the hollow sphere of the shell:

1.) Interstices of bullets filled up with charcoal dust,.....the *new English Shrapnel*, as proposed by Captain Boxer.

2.) Interstices of bullets filled up with solidified sulphur,.....the *Dutch Shrapnel*, as proposed by Colonel de Bruyn (Delobel. *Revue*, I. Pl. I, fig. 4) (**).

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tion 3d. volume "*Geschichte des Belagerunskrieges.*" Berlin, 1835. § 228, p. 272, in which this author ascribes the invention of the Shrapnel projectile to a Swedish workman, a smith, named *Neumann*. A similar Shrapnel was cast in Belgium (at the Royal cannon foundery at Liege) for experiment in 1833, in which, however, no bullets, but small bits of cast iron having the form of truncated pyramids, surrounded the spherical chamber. This projectile answered its purpose no more, than those in which the bullets were fixed by means of pitch or plaster of Paris.

(*) And the Prussian Shrapnel of similar construction, interstices left empty.

(**) Respecting this Shrapnel I have to rectify an error, which an experienced Dutch Artillerist, General Van Meurs, late Minister of war, was so kind as to notice to me in a friendly letter of May 19, 1859 (Ministry of war, Ordnance Office, N° 36, B.). While fairly admitting

In respect to being able to support the carriage in limber and ammunition waggon without deranging the intended position of the bullets, the Shrapnels in which these are fixed by means of sulphur, pitch, etc., occupy, of course, the first rank; viz: the Dutch and the Hanoverian; then follow

2d, the Belgian;

3d, the Hessian and the new English; and

4th, the old English Shrapnel.

But in the second of these categories the bullets are *sufficiently* fixed, whereas this important condition is less perfectly fulfilled in the third, and unattainable in the fourth.

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that the Siemens and Breithaupt patterns of time fuze constitute in principle but modifications, more or less important, of my invention viz. the Belgian metallic fuze, the Minister says:

"If it be true that the timing of the Siemens fuze sometimes offered difficulties to our *savants* this, however, is not the motive which led us to reject the system of that distinguished Artillerist; but in truth the determining fact was, that at the end of one year, the interior charge of the shell was found deteriorated whether the Shrapnel was kept in magazine or in the limbers".

Thus in Holland for sufficient reason the Siemens method of fixing the bullets by sulphur was rejected and with it De Bruyn's vicious plan to arrange the bullets in the shell; but for what specific reason the metallic fuze shared the same fate, does not appear.

§ 12.—Lastly it may be remarked that the Boxer shell must necessarily be more expensive than the Belgian shell, on account of the difficulty of casting it and on account of the great waste in castings of such complicated nature. The difference of price perhaps, may be such that 1000 empty Boxer shells will hardly be had in the workshops of the Royal Laboratory at Woolwich, for the price of 1500 empty Belgian shells (*). Adding to this that the price of 1000 Boxer fuzes, as we shall see hereafter, may be estimated to be from 2500 to 3000 francs (from £ 100 to £ 120), while 1000 Belgian metallic fuzes cost only 350 francs (£ 14), it will be readily agreed, that on this point also the Belgian system is more advantageous than the new English one (**).

Expensiveness of the new English Shrapnel shell.

(*) The difficulty of casting the Boxer shell may be appreciated by the following statement: Quarterly Review, January 1858. London. Art. VII. *Woolwich Arsenal and its manufacturing establishments*, p. 221. " A still stronger case to show the extraordinary prices which the Go- " vernment had to pay contractors when the demand was imperative " and supply confined to two or three houses, was that of the 6-pounder " diaphragm shells : £ 73 per ton, now made in the Royal Laboratory " at £ 14-19-2 per ton."

(**) These prices, of course, will have changed since 1859, but a difference of price in favour of the Belgian system will still exist.

Colonel Delobel on the Boxer fuze and on the Boxer Shrapnel shell.

§ 13.—Endeavouring myself to remain perfectly impartial on the Boxer system, I here subjoin Colonel Delobel's observations on the same subject. Colonel Delobel after having laid down, *Revue*, II, p. 388, the fundamental conditions, which in his view constitute a good Shrapnel system, concludes p. 390: "Now, if we examine the Boxer system, we " find that it is far from satisfying all these con- " ditions and that its principal deficiencies consist " in this, that":

1st. "It (the shell) can contain only a small num- " ber of bullets as the following comparative table " shows:

SHRAPNELS.	NUMBER OF BULLETS SHRAPNEL OF			OBSERVATIONS.
	24 lb	12 lb	6 lb	
Belgian.	201	100	49	The Boxer bullets, besides this, are lighter than leaden bullets.
Baden.	180	86	32	
English (old system).	128	63	27	
Boxer system. . . .	121	56	20	

2d. "The plan of the projectile, the position of the

" bursting charge and that of the diaphragm must
" hinder the timely bursting of the shell, and hence
" obstacles will occur to the regular march of the
" sheaf of bullets, and consequently a great dimi-
" nution of the average efficiency of the Shrapnel
" fire".

3d. "The bullets being introduced into the pro-
" jectile by way of the ampoulette, it must be dif-
" ficult to introduce always the same number of
" them: hence inequality of weight between Shrap-
" nels of the same calibre and consequently ine-
" vitable irregularity in fire".

4th. "The charcoal dust, mixed with the bullets,
" will not hinder their being deranged during the
" carriage, and their pushing back into the ampou-
" lette the stopper disks (*disques obturateurs*),
" which are not fixed and, in this case, it will be-
" come impossible to drive the fuze down to the
" bottom of the ampoulette". (*).

(*) Later information has shown that these disks were sufficiently fixed in the brass ampoulette.

5th. "The series of operations necessary *at the* " *very moment of the fire* for the preparation of " the Shrapnel, the regulation of the fuze and the " driving it into the ampoulette, will require too " much time; without taking into account that, " if all this may be done properly and without " error on the practice ground, it would not be the " same on the field of battle, for the complete " boring of the regulating-hole up to the column " of fusing composition, the introduction of the " fuze into the ampoulette, so that the row of cy- " phers correspond to the groove and its hole or " vent (*lumière*), and especially the driving home " the fuze into the ampoulette, are things very " difficult to do rapidly and well during the ex- " citement of battle and amidst a thick smoke, " and which will certainly occasion a great num- " ber of failures in igniting and premature burs- " tings".

6th. "The Shrapnels must come to an excessive " price, for, according to an approximate estimate " which we have made, the ampoulette and the fuze " together cannot cost less than from 2 ½ to 3 fr.

" (from 2*s*. to 2*s*. 4 $\frac{5}{10}$ *d*.), which is already more
" than the cost of one common shell of 24 ℔
" charged, or two balls of 12℔ or four balls of
" 6 ℔"!

§ 14.—These considerations, I hope, will be sufficient to establish the conviction, that the new English Shrapnel system, compared to the Belgian, is inferior in its principal points; viz :

The new English Shrapnel system inferior to the Belgian system.

1st, with respect to the fuze;
2d, with respect to the construction of the shell;
3d, with respect to the manner of transforming the shell into a Shrapnel; and
4th, with respect to the monetary sacrifices necessary for its application.

I do not mean to say, that no good effect at all might be obtained with the Boxer fuze and with the Boxer Shrapnel; some excellent execution may be done with one and the other, especially on the practice ground and even in the field, as was the case with General Shrapnel's spherical case-shot and as it may be still with any of the fuzes and shells of the other mentioned systems; but in

war operations the essential point is certainty of efficient execution.

Moreover, it must be noticed that, of course, different combinations may be applied in making use of the elements of one system with those of another, and that accordingly more or less may be effected with such a disposition. The Belgian metallic fuze, for instance, may be used with the shell or the Shrapnel of any other system, the Boxer fuze with General Shrapnel's original projectile and with any common shell, but not to any advantage with the Belgian Shrapnel. We may add to this that the diaphragm may find its useful application in particular cases, as well as the imbedding of the bullets in sulphur, pitch or plaster of Paris.

And after all, wood being a body which easily absorbs and readily yields moisture, fuzes with wooden cases, will be always inferior to those having metallic ones *hermetically* closed, especially if the fusing composition is in immediate contact with the wood, as in the old common and in the

Boxer fuze. The importance of this remark will be felt particularly on board war-steamers, stationed in hot climates (*).

Origin of the projectile now called *Shrapnel shell* and the *Hagelkugel* of the Germans in the 16th Century.

§ 15.—In reference to the *origin* of the projectile now called *Shrapnel shell*, it is generally believed to be an English invention, in which sense consequently my opponent also states page 165 : "It is " about fifty years ago, that Henry Shrapnel, then " a captain of artillery, invented the shell, which " has since become of European reputation. His " idea, a simple one, when explained, was yet " one of those simplicities which only strike a " genius, and which are based on extensive know- " ledge."—This, however, requires some rectification.

(*) As to the common fuze with metallic case, adopted by the English Navy and in which the fusing composition is equally in immediate contact with the metal, they also are liable to be easily damaged by moisture. Captain Dahlgren (*Shells and Shell-guns*, p. 142) says in that respect : "The decided affinity between the nitre and sulphur of the " latter (viz. the composition), and the bronze is quickly developed by " the moisture of the sea air, to the detriment and final destruction of " the composition,—and this cause is rendered still more active in stea- " mers, by the escape of the hot and moist vapour from the machine, " which pervades every part of the vessel; so that, without extraordi-

The Shrapnel shell is a German invention of the sixteenth Century, as has lately been discovered.— For this discovery, the Germans are indebted to a distinguished officer of the Royal Prussian Artillery, Captain Toll, who in his historical researches found, in the library of the Heidelberg University, a manuscript of the year 1573, which incontestably proves that the German artillerists of that epoch knew perfectly well the principle on which the present Shrapnel fire is founded, and that notwithstanding their rather limited means, they had even succeeded in the application of this projectile, which then was called "*Hagelkugel*" (hail-shot).

This interesting manuscript, of which Captain Toll published in 1852 an extract in the Prussian *Archiv* (*), forms part of the "*Codex palatinus*", No. 258, folio 32 et 33, and bears the title of "*Dia-*
" *logus or discourse between two persons, viz :*

" nary care, all kinds of laboratory stores are liable to speedy deterio-
" ration in such ships, as I have had occasion to notice in those returned
" from service."

(*) *Archiv* für die Offiziere der Königl. Preuss. Artillerie- und Ingenieur-Corps. Berlin 1852. 32ter Band, p. 160.

" *a Büchsenmaister* (an artillery officer) *and an* " *Artificer in reference to the art and true use of* " *projectiles and artifices, etc.* By Samuel Zim- " mermann, of Augsburg 1573 (**)." On the margin of it is noted the characteristic passage : "Hagel- " kugel die sich über ettlich hundert schritt " aufthuet;" that is to say : "*Hail-shot which dis-* " *closes itself at some hundred paces distance* " (from the piece)"; which phrase alone indicates the knowledge of the principle under consideration.

This *Hagelkugel* consisted of a leaden shell or rather box of cylindrical form; its fuze was the old common fuze placed in the axis of the shell and at one end of the cylinder, the bursting powder surrounded and covered the fuze in the interior of the shell; the rest of the empty space of the shell was filled up with "*hail*"—pieces of iron, bullets

(**) In its original old German language : " Dialogus oder Gespräch zwayer Personen, nemlich aines Büchsenmaisters mit ainem Fewerwerkher von der Khunst vnd rechten Gebrauch des Büchsengeschosz vnd Fewerwerkhs, etc., durch Samuelen Zimmermann, von Augspurg. 1573."

or even pebbles —and lastly the shell was suitably closed up at the other end. This projectile was introduced into the gun so that its fuze was turned towards the charge of the piece; the fire with it seems to have been successful to such a degree that it was employed in action. As a proof of this latter circumstance, Captain Toll refers also to the siege of Gennep (on the Maes) which took place in 1641. (Vol. 24, p. 185. Prussian *Archiv*. Berlin 1849).

As to the reasons which may have contributed to the oblivion into which this projectile had fallen, Captain Toll establishes the following suppositions : "At first sight it may strike the reader " that in the contemporary printed works on " artillery this invention is not mentioned; but " this is easily explained, considering : first, that " artillery had always secrets which, at that time, " when artillerists formed a distinct corporation " and arcana especially stood high in price, were " concealed from the public with still more care " than at present; next, that the authors of those " printed books, particularly German, were chiefly

" bunglers or no professional artillerists at all,
" as may be said even of the often quoted Froms-
" perger, who being only a compiler (and a very
" uncritical one too, respecting artillery) had
" gained, without any right, the renown of one of
" the creators (*Altvater*) of the German Artillery.
" At all events it must be granted that, as long as
" the contrary is not proved, it is to the German
" artillerists that the honour is due of having had
" the first idea of the Shrapnel and of having in-
" troduced this projectile into practice. It is not
" entirely their fault, that they have not improved
" it farther, that they, after having let it sink into
" oblivion, have not been the first to take it up
" again; for, it is well known that German inven-
" tions, at all times, have met with adoption in
" Germany, only after having returned into their
" fatherland from foreign countries under foreign
" names."

Whether General Shrapnel had knowledge of the *Hagelkugel* of the Germans and of the principle of its application; or whether this was not the case and that he,—as General Sir Howard

Douglas states in his works on naval gunnery (*),— was also an inventor of both, principle and shell; it is incontestably true, that General Shrapnel rendered eminent, everlasting services to his country in particular, and to the art of war in general, in having proposed this projectile. His perception of the real value of it,—an insight which is not yet common in our days;—his having predicted with rare and astonishing foresight the immense advantages which this projectile is capable of affording; and having shown how to apply for this purpose an iron shell and the old wooden fuze, which constitutes quite a new projectile:—are equivalent to as many new inventions of great value, and it is probably not his fault, if England has failed to profit by them to their full extent.

I, therefore, agree willingly with what my opponent states respecting the eminent merits of this great artillerist—and every impartial man will do so;—but we Germans have also an incontestable

(*) *Naval gunnery*, 3d edition, 1851, p. 425; 4th edition, 1855, p. 427; 5th edition, 1860, p. 482.

right to claim in honour of truth, that the invention in question, which the world appears inclined to attribute solely to General Shrapnel, may be considered not only in Germany, but also in other countries, as due to German genius.

And particularly we may admit, that the present Kingdom of Bavaria is the *cradle* of the art of throwing this highly effective case-shot at all distances attainable with our guns, and the present Kingdom of Saxony, *that* of the art of directing this powerful fire with an astonishing precision, by mastering the rotary motion of the Shrapnel shell during its flight to its point of explosion: two inventions the value of which is not yet fully appreciated, but which are, in my eyes, of superior importance to the invention of rifled ordnance pieces,—also of German origin,—inasmuch as in the great majority of cases occurring in war operations these pieces would hardly pay the expences they cause if Shrapnel shells should be excluded from their ordnance stores and as a considerable amount of destructive force would be given up if both of them were not utilized in the

application of smooth bored pieces, especially of howitzers and mortars.

Nature herself appears to have first exhibited an effect similar to that of our present Shrapnel fire (*).

General Shrapnel's spherical case-shot in the wars from 1808 to 1815.

§ 16.—The lessons taught by history are rarely taken into sufficient consideration, and this was also the case with Shrapnel fire. It is not within human power to bring at once to its maturity an invention capable of such extensive application and productive results as Shrapnel's spherical case-shot. This General had done in its contrivance what only a genius like his could, in his time, accomplish; but the projectile still remained imperfect in some respects. This imperfection was the direct cause why the effect produced with it during the wars from 1808 to 1815 in Portugal, Spain and Belgium against the troops of Napoleon, in general failed to justify the high reputation it had already acquired in theory, and, consequently, did not gain

(*) Note E.

the approval of the Commander in chief, the Duke of Wellington, nor that of the highest and most experienced officers commanding under him the Royal British Artillery (*). Round shot, common case-shot and common shell, therefore, were the projectiles preferred by them to spherical case-shot.

This want of perfection was moreover the cause why the French in those wars did not suffer from the English Shrapnel fire so much, as undoubtedly would have been the case, if this projectile had been more fit for field service,—and lucky enough it was for the English, that Napoleon's attention had been turned away from this subject; for, if his orders to examine some non-exploded spherical case-shot, picked up on the fields of battle in

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(*) Among them Sir Robert Gardiner, Sir John May, Sir Alexander Dickson, all consummate artillerists. And General Sir Julius von Hartmann, a very experienced and able German artillerist, who, in the Peninsular war, commanded the artillery of the German Legion, seems to have attached, at that period, no more value to spherical case-shot than the above mentioned British officers. This projectile, at least, is visibly neglected in the interesting *Reminiscences* the General left to his family and which have been published by one of his sons in a biographical sketch bearing the title : *Der Königl. Hannoversche General Sir Julius von Hartmann.* Hannover, 1858.

the Peninsula, had been executed in France with sufficient energy (*), the French might have discovered the true function of this projectile and applied it against their enemies. In the present day, it is evident, other reasons exist which prevent the rendering of full justice to the Shrapnel projectile in France.

This imperfection was finally the real cause why the German artillerists hesitated for a long time to adopt their newborn infant, though regenerated by the genius of General Shrapnel in a more perfect shape; but, be it said to their honour, since the fuze question has received a more satisfactory solution, they foster it so well, that their former injustice towards it is already forgotten.

It is essential also to remark that notwithstanding the imperfection of General Shrapnel's original shell, several decisive effects had been obtained with this projectile in the wars from

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(*) Terquem et Favé, p. 18; — General von Decker's original work "*Die Shrapnels*", p. 24;— and "*The British gunner*", 1828. By Captain J. Morton Spearman. Art. Shrapnell Shell.

1808 to 1815 against the French : at the late siege of Badajoz, for instance, and at the battle of Waterloo; two remarkable events which I particularly select, because I have been favoured with information respecting them, in letters from two much esteemed friends of mine, which letters I here submit to the reader (*) as being of real historical value.

Similar cases will probably have occurred in the sieges and battles which British troops fought from 1815 to 1852 in other parts of the world : in India, etc., but all these extraordinary results have not been sufficient to excite the public attention in England so far, as to induce British artillerists to pursue General Shrapnel's labours, the reason of which may perhaps be found in the circumstance, that the English never met on the field of battle an enemy able to oppose to the spherical case-shot a projectile of equal or superior power(**). An analogous circumstance happened in the French

(*) Note F.
(**) Note G.

army under Napoleon I, who, himself an artillerist, suffered his artillery to fire their shells with the old wooden fuze timed for the maximum of range, and acting consequently in general at all intermediate distances, merely as cannon balls,—which constituted a great waste of ammunition. Here also the enemy opposed to these imperfect shells no better conditioned ones, the English excepted with their spherical case-shot, but who, as already mentioned, could not make the effective use of it which they might have done.

On the use of English spherical case-shot in the Crimean war of 1854 and 1855.

§ 17.—This sort of good fortune seems to attend both these armies; for they again escaped in the late Crimean war (1854-1855) a great additional danger, to which they would have been inevitably exposed, if the Russian Artillery had been able to employ the means of destruction here under discussion.

Considering that, if the enemy possesses destructive means of an inferior order only, it is not less advisible to employ superior ones against him, as an overwhelming power of this kind may shake his

physical and moral forces to their very foundation, and lead so much the sooner to the final desired issue of the strife, as the enemy disposes of less equivalent means; it, therefore, is difficult to imagine what may have been the real cause, which, on this occasion, deprived the English Army and Navy, — and, no less the French Army and Navy, — of so mighty an assistance as that which a well organized Shrapnel fire would have afforded them in all their operations. Was it unavoidably or voluntarily that their commanders in chief renounced the aid of such a powerful destructive force? — It is not within my province to answer this question, nor do I feel inclined to criticise the dispositions which brought this ever memorable struggle to the desired end. The allied powers were victorious, that is what was wanted; but, as the different feats of arms by which this victory was gained belong now to history, I think, there is neither indiscretion nor presumption in bringing a few of these feats under general consideration, and in showing what in this case could have been done with the Belgian Shrapnel system, applied according to my plan. This discussion

will tend to indicate more readily what may be done in future in similar cases, and, I believe, will be found to justify the opinion I advanced on this subject at the beginning of the present dissertation. With this view let it be remembered from § 3, that the ordnance stores of the English Army included Shrapnel, which was General Shrapnel's original shell with Captain Boxer's fuze, and which consequently may be considered as an improved Shrapnel.

None of the few English, French and Russian accounts of the operations in the Crimea, which I have been able to procure, speak of English Shrapnel fire. If, therefore, the Royal Artillery made use of the just mentioned Shrapnel in the open field — in the battles of Alma, Balaklava, Inkermann, etc., — the effect produced with it cannot have been powerful enough to distinguish it from that obtained by their common shells. A work, for instance, every line of which seems to be pure truth — as far as truth may be ascertained during and amidst occurences of war-operations,—"*Letters from Head-Quarters*" second edi-

tion; London, 1857, relates the effects which its author saw the English obtain under his own eyes by means of their round-shot, red-hot shot, common case-shot, common shell and bomb, war-rockets, Lancaster shell, Minié's rifle projectile, and bayonet; but not a word of Shrapnel.

As to the siege, properly speaking, it appears that Shrapnel fire was used rather sparingly by the English against Sebastopol. On the very last day, however, the 8th of September 1855, a very powerful and successful application of it was made against the "*Redan*" from Battery 7, which was situated on the left attack of the English and about a thousand yards distant from the enemy's work. This battery was manned by a detachment of the Royal Naval Brigade, whose officers, happily for their storming countrymen whom they had to protect, had conceived the idea of firing from a 68-pounder (8-inch or 0m.20 gun) some of the 8-inch Shrapnels they found in this battery in store. The initiative thus taken at such a trying moment by these officers does great credit to their sound and practical judgment respecting ordnance service;

they also were rewarded on the spot for this gallant deed, as the effect of this fire is said to have been striking. I have it on the statement of a competent eyewitness, that whole lines of Russian troops, who successively sprang on the breastwork of the Redan for defence, *were literally mowed down each time by this fire.* And, therefore, it is not to be doubted that the English in many other cases during the Crimean war might have obtained similar results with this projectile.

The Hail-shell system.

§ 18.—All the Shrapnel systems in use at present, the Belgian excepted, comprise, as far as I know, only one single projectile, viz : a *simple Shrapnel* to be fired from guns, howitzers and shell-guns; but the system I have advocated in the foregoing paragraphs, comprises four : 1st, a simple Shrapnel; 2d, an incendiary Shrapnel, 3d, a simple Shrapnel-bomb and 4th, an incendiary Shrapnel bomb (*).

In order to indicate in one word a projectile

(*) *Expériences sur les Shrapnels.* Par Bormann. Paris, 1848, p. 56. — System proposed in 1835 and 1836 to the Royal Belgian artillery.

belonging to this system, which, of course, includes the use of the Belgian metallic fuze, the Belgian shell and the mode of transforming this into a Shrapnel according to my propositions, I beg leave to designate this system *provisionally* by the term of *"Hail-shell system"*, so that I may be easily understood in speaking of: *hail-shell; incendiary hail-shell; hail-bomb;* and *incendiary hail-bomb;* after having summarily explained the qualities of these new projectiles, as follows:

A.) In the *incendiary hail-shell* the bullets are replaced principally by metallic incendiary bodies (cylinders), each of which weighs from $2\frac{1}{2}$ to 3 times as much as the musket bullet belonging to the simple hail-shell of the field calibre and in the *hail-bombs* by solid or incendiary bodies of nearly equal weight, say of 0·200 (7 or 8 oz. English) in mininum.

B.) The *incendiary hail-shell* is principally constructed for fighting the enemy's artillery at *all attainable distances* with much more success than by means of simple Shrapnel or common shell, on account of the much greater probability of blowing

up their limbers and ammunition waggons. The 12- and 24-pounder hail-shells, for instance, contain, besides the metallic fuze, from 13 to 15 incendiary bodies. If necessary, the incendiary hail-shell may replace the simple hail-shell and evidently with considerable advantage at the greater distances; it replaces also the common incendiary shell, and in case of need even the common shell acting only by its splinters. The incendiary hail-shell, as well as the simple one, may finally, in case of *utmost need,* be used instead of common case-shot. The simple and the incendiary hail-shell being of the same weight as the solid shot, these three projectiles require but one and the same tangent-scale (*hausse*) or table of ranges; and hail-shells of the same description are, as nearly as possible, of the same weight.

C.) The *hail-bomb* is calculated to be thrown from mortars and to furnish such efficacious *vertical fire* as the illustrious Carnot projected, but which his *canister* thrown from mortars, never was nor will be able to produce. Carnot's fire may be improved in applying heavier than the

originally proposed 4 oz. balls, for instance balls of 8 oz. with which the Bengal Artillery have obtained, on the statement of Captain Straith, "a very full and powerful effet (*)", but even then it will not equal in energy the fire of the hail-bomb, as the former fire spreads itself from the mortar's mouth, the latter only from a determined point in the descending branch of the bomb's trajectory. General Shrapnel himself in is pamphlet "*The gunner's Guide,* London 1806" — which I know only from an extract (**), — speaks already of "a perpendicular shower of case-shot", but neither the English nor any other nation that I know of, have ever made use of it, most probably from want of proper means; for this fire hardly can succeed unless the hail-bomb be prepared on correct principles comprising, as most essential, the use of the metallic fuze.

The simple and the incendiary hail-bombs are of

(*) Straith. *A treatise on fortification with a memoir on artillery.* London, 1836, p. 80 of the memoir.

(**) Borkenstein. *Essay on artillery* (Versuch zu einem Lehrgebäude der Artilleriewissenschaft. Berlin, 1822. Tol. I, p. 241).

equal weight and require but one table of mortar practice; the latter bomb may replace the former and both, if necessary, the common bomb, especially in breaking into vaults and buildings, on account of their superiority in weight or incendiary power. Hail-bombs of the same description are, as nearly as possible, of the same weight.

D.) Finally it may be added here that the Belgian metallic fuze, contrary to the strange assertion of some military writers, is perfectly fit for the fire of common shell and bomb, whatever be their calibre, shape or construction; this fuze, indeed, was never *exclusively calculated* for Shrapnel fire, though at first it was applied to it. In several artilleries, moreover, the metallic fuze has been more or less modified,—evidently with the view to improvement; but sometimes the contrary has been obtained. Thus, for instance, in Baden the plate which ought *hermetically* to shut up the small charge of grained powder destined to convey the fire from the fuze to the bursting charge of the shell, is perforated with six little holes before the fuze is fixed to the projectile (Schuberg.

Hanbbuch der Artillerie-Wissenschaft. Taf. V, and Delobel. *Revue*, II. Pl. V.). If, in this case, the powder in the shell contains water in a greater proportion than the powder and the fusing composition in the fuze, these two will readily absorb as much moisture as will be necessary to establish the equilibrium, and this may alter the fuze to a certain degree.

§ 19.—The application of such a Shrapnel system, I am convinced by numerous experiments, might have exercised the most salutary influence on the march of the operations in the Crimea.

Notable service which might have been derived from the application of the Hail-shell system in the late Crimean war.

In the *Letters from Head-Quarters,* I. p. 155, the following fact is stated under the 19th of September 1854, the day before the battle of Alma : "The " enemy advanced also slowly, still with his skir- " mishers in advance and firing. These move- " ments on both sides went on for some ten mi- " nutes, when what appeared to be a squadron " of cavalry came down from the left of the " Russians towards our cavalry. When half-way " down the hill they halted, and the squadron

" opened in the centre, and wheeled back right " and left, and discovered a battery of guns. One " of these was instantly fired—the first gun of the " campaign".

The English fired at them forty rounds of shot and shell, it is said, with considerable effect (*), which determined the Russians to retire; but had the English Artillery on this occasion fired *incendiary hail-shell,* they would have had the greatest chance not only of disabling more men and horses, but also of blowing up some of the Russian limbers or ammunition carts. A much greater moral effect, discouraging the enemy's troops and encouraging their own, would evidently have been the result of this, and many similar facts, no doubt, would have frequently occurred to increase this impression

(*) *Letters*, p. 157. "Our casualties were four men wounded (two am- " putations) and five horses killed, all of the cavalry. We had no means " of ascertaining at the time the loss of the enemy, except by seing the " bodies of several horses lying about; but we have since heard that " they lost twenty-five men killed and wounded." A Russian officer, however, Capt. Anitschkof, in his work "*Der Feldzug in der Krim*". (Translated into German by Lt. Baumgarten. Berlin 1857). I, p. 8 states that the loss of the Russians on this occasion, was only : 4 men killed, 5 men wounded and 2 officers contusioned.

in the succeeding more serious encounters with the enemy in the open field. As instances which might have been particularly favourable for application of the incendiary hail-shell, I cite only the following in reference to circumstances related in the above mentioned "*Letters*" :

a.) In the battle of Alma (I, p. 178) Captain Turner's battery (C) against the 18-guns battery and against the retiring enemy.

b.) In the battle of Balaklava (I, p. 312) the English batteries against the numerous Russian artillery.

c.) In the battle of Inkermann (I, page 377) Colonel Dickson's two 18-pounders (C) against the Russian batteries upon Cossack Hill;—and so in all cases where the enemy's artillery was in great number.

Shrapnel fire in general ought to have been the leading fire for artillery in these battles, on account of the configuration of the ground in that

part of the Crimea, and on account of the known character of the Russian soldier (*); and, if well organized and directed, it decidedly would have produced extraordinary effect, which could not have failed to attract public attention, as the improved fire of the English Infantry did at Inkermann.

As to the besieging operations, the weakness of the defences of Sebastopol on the southern side of the town, opposite the English and French positions, was the most happy circumstance the allied armies could meet with ("*Letters*", vol. I, p. 265, etc.). The fire of simple Shrapnel (spherical case-shot), wisely combined with the fire of ordinary shell and bomb, would have formed proper means to hinder

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(*) On the latter subject see Captain Pönitz *Militärische Briefe eines Verstorbenen.* Adorf, 1843. End of the 26th letter, in which, after having mentioned the *tenacious resistance* of the Russian troops at Zorndorf, Kunnersdorf and Borodino, he warns the Germans of them in the following words : "Bis dahin übt Euch fleissig in Vervollkommnung der Granatkartätschen, die, nebst den Kanonenkugeln, das wirksamste Mittel sind, so zähe Massen auseinander zu sprengen". That is to say : In the mean time exercise yourselves diligently in perfecting Shrapnel shells which, together with cannon balls, are the most efficacious means of scattering such tenacious masses.—See also Ludwig von Wissel, major of artillery : *Interessante Kriegs-Ereignisse der Neuzeit.* Hannover, 1846, 3d number, p. 58.

the Russian garrison from strengthening these defences so rapidly and efficiently, as was done under the very fire of the besieging batteries, thanks to the genius of General von Todleben; but if these batteries had been enabled to make use of a Shrapnel system such as the hail-shell system, the effects produced must have been incomparably greater.

The situation of the Russian lines, especially those opposite to the attack of the English, was such as to offer frequent opportunity of enfilading parts of them incompletely or completely, even of taking some in the rear, but without permitting ricochet fire to any considerable advantage. Hail-shell, simple and incendiary, fired at them, according to circumstances, in more or less curved trajectories, would therefore have created insupportable annoyance to the Russians. Adding to this a well directed fire of hail-bomb, it will be possible to form a correct idea of the ultimate effect these mighty means of destruction would have exercised on the progress of the enemy's works, on the efficacy of his fire, on the movement of his forces and ammunition in the place, and, finally

on his moral state; and all this in spite of his having had the immense advantage of being frequently relieved by the arrival of fresh troops.

In many cases it was known in time to the besieging troops, which were the hollows, ravines, etc., where the Russian troops assembled at night, often in considerable numbers, in order to attack the French and English trenches; incendiary hail-shells, — on account of the weight of their incendiary cylinders, — admitting of very curved trajectories, thrown from howitzers, and hail-bombs thrown from mortars on these crowded masses, would have had the most disastrous effect on them.

Lastly it may be said, that hardly a more suitable projectile could have been employed than the hail-bomb to drive the Russian sharpshooters out of their renowned *Rifle-pits* and interrupt their communications with their defences in the rear. In the pits, for instance, which the English troops called "the ovens", some 200 riflemen were crowded together who, according to the "*Letters*", I, p. 436, "not a little" annoyed the men in a portion of the

English and French trenches; these pits and others (as the "*Quarries*" — *Letters*, II, page 247), were throughout the whole siege an object worthy of consideration. The ease with which an effective fire of this kind might have been directed against them, will be appreciated by the following statement of the results I obtained (1841 and 1843) with 8-inch hail-bombs (60 ℔ Belgian or 68 ℔ English calibre) thrown from a brass mortar the weight of which was only about 551 $\frac{27}{100}$ ℔ English (250 kilogrammes), so that a few men could easily carry it to any convenient spot. The hail-bomb weighing 60 $\frac{64}{100}$ ℔ English (27ᵏ500) yielded generally some fifty heavy deadly fragments, which obtained on the level ground on which the mortar was placed an average range of 600 paces (450 yards or mètres) under the following conditions of the fire : Charge of mortar 3/4 ℔ Engl. of powder (0ᵏ340); elevation 45°; trajectory, the inferior (*); time of fuze 13 seconds; height of the bursting point over

(*) *Expériences sur les Shrapnels.* Par Bormann. Paris, 1848. Tab. 2. *Classification of the trajectories* which may be obtained by an *eccentric projectile.*

the soil, about 17 yards or mètres. The fragments of this bomb (splinters, fuze and bullets) generally spread over a surface similar in shape to the section of an egg made along its axis, the pointed part turned towards the mortar and the length of which was about seventy-five yards or mètres, its largest breadth forty. The effect of one single fire, produced under the very same conditions on a wooden floor forming a square of 15 yards, (13 ½ mètres) and about one inch Engl. (26^{mm}) thick, placed flat on the ground at 450 yards, was, that this floor with part of its frame, was pierced through and through by seven splinters and thirty-seven bullets, scattered over the whole square as gun Shrapnel fragments do over a vertical standing target. The gunners serving the mortar were not screened by any parapet or mantelet.

The necessity of using vertical fire against the works of Sebastopol was but too well felt at the English Head-Quaters, as is plainly proved by "*Lettters*", Vol. I, p. 339, in which the author at the end of October 1854 or nearly a year before Sebastopol surrendered, states : "They (the Russians)

" have been, for some time past, making very " large earthworks in rear of the Redan and Bas- " tion du Mât batteries, and in spite of our inces- " sant fire they continue to increase the batteries " in the neighbourhood of the Malakoff tower. All " these great inner works are but little affected " by our fire, as their outer or front line of de- " fence acts in a great measure as a screen to the " inner one. I believe therefore the only thing " that would silence the guns in there would be " to bring an overwhelming vertical fire from " mortars to bear upon them; but, unfortunately, " we have but a limited supply of this species of " ordnance".

A very correct judgment, with the exception that the want of mortars in this case was no valid excuse; since the Shrapnel at the disposal of the English, if fired from howitzers and guns *on rational principles*, would have done very valuable execution. I must be allowed to say, that the generally rare application of vertical fire by the artilleries of the allied powers in the siege of Sebastopol, was the subject of remark in Belgium, founded on the re-

ports of the public papers and before the "*Letters from Head-Quarters*" could have reached England. The immense losses in men, which the allied powers sustained, especially in the last two stormings of Sebastopol, as a natural consequence of their artillery not having previously used improved vertical and Shrapnel fires, were pretty nearly predicted in verbal and written considerations, which I was induced to address, at the outset of the siege, to several eminent persons in the Belgian and English Army, who are able to certify this fact.

The explanations above given, I hope, will put it in the power of my reader to form his own judgment on the change. which the application of a Shrapnel system like that of the Hail-shell system might have operated on the result of the different attacks on Sebastopol, especially supposing that the French Artillery also had had such a fire at their disposal, and that some of the wise propositions of General Sir John Burgoyne, Royal Engineers,—which were subsequently fully approved by Field Marshal Lord Raglan,—had not been ultimately forgotten; for one of the most important of these

propositions was : to reduce the enemy's artillery sufficiently, before attempting to storm his works ("*Letters*", Vol. I, p. 238). But at all events it would be highly interesting and useful for the future, to know the opinion on this point of competent eyewitnesses; and it is particularly to be wished, that such eminent military Engineers as Sir John Burgoyne and General von Todleben would be pleased to explain to us : Whether on the side of the Allies well founded hopes could have been entertained of so far impeding the Russian engineering works and protecting their own by such an additional overwhelming fire of artillery, as to have spared the allied troops, if not the three last stormings on the 7th, the 18th of June and the 8th of September 1855, at least one or two of them. And on the Russian side : What hopes General von Todleben would have attached to the possession of an artillery, with such extraordinary means of destruction; and, what additional advantages the Russian arms would then have derived from the rocky ground, the scarcity of earth, the want of wood round Sebastopol and from the generally bad condition of the English and French trenches, so fre-

quently mentioned in the "*Letters from Head-Quarters*" and in other accounts.

Remembering the surprising effects which the celebrated Vauban at the siege of Ath (1697) and several other fortresses was able to produce with his *ricochet fire*, I do not hesitate to say, that Hail-shell fire, applied against the works of Sebastopol as well as from them against the English and French trenches,—in none of which two cases ricochet fire was advantageously applicable on account of the configuration of the ground (*terrain*) as already indicated,—would have been able to produce comparatively much more important and decisive results.

Shrapnel shells fired by the French and Russian Artilleries in the Crimea.

§ 20.—The French also fired some Shrapnels in the Crimea but, as Colonel Delobel states, only occasionally towards the close of the battle of Tchernaya or Traktir bridge, August 16th 1855, and the effect of this fire, directed on the dense masses of the Russian retiring troops, is said to have been excellent (*). A Erench author, however, Major du

(*) Note H.

Casse, reporting particularly in his work on "the immense and most brilliant part the French Artillery played in this glorious and grand affair", as he expresses himself, does not mention Shrapnel fire at all, unless he comprises such fire in the words of *"tir à mitraille"* (*). It, therefore, appears to be evident, that the Shrapnel shell was not yet duly appreciated in France in 1855, notwithstanding her troops had suffered from the fire of this projectile from time to time in former wars, and so much more inconceivable is it, how General Paixhans in his work : *"Constitution militaire de la France,"* published in December 1849, could pretend, that already at that time, this projectile had been considerably improved in France (**).

(*) *Précis historique des opérations militaires en Orient*, de mars 1854 à septembre 1855. Par A. du Casse, chef d'escadron d'état-major. Paris, 1856, p. 333.

(**) Paixhans. Page 248. *Sur les projectiles à balles (Shrapnel)* : " Les projectiles creux remplis de balles de fusil, proposés par l'artil- " leur anglais Shrapnel, ont d'abord été employés avec assez peu d'effet; " mais ils ont récemment reçu en France des perfectionnements consi- " dérables." This illustrious artillerist, with not better reason, has made nearly the same pretensions as to the application of the Equilibration *(équilibrage)* of spherical projectiles. (See *Revue de technologie militaire*, I, p. 419.—Notice historique.)

The Sardinians were not unacquainted with the newest improvements of the Shrapnel shell (*), but the pieces of artillery which in the month of May 1855 were sent to the Crimea with the Sardinian contingent were not provided with this projectile. Their artillery consequently was prevented from affording their gallant comrades a still more effective support than that which their known skill enabled them to render by means of the old common projectiles of artillery.

The Russians, from whom the use of Shrapnel shell in the war in question was least to be expected, tried however to derive some service from this projectile. Colburn's Magazine for November 1854, states, p. 338 : "The "*Tiger*" of 16 guns, Capt. A. W. " Giffard, with a complement of 226 officers and " men, was stranded, during a dense fog near " Odessa in the Black Sea, on the morning of the " 12th May 1854. A Russian field battery, on the " rocks, about 200 yards from her, threw spherical

(*) Colonello Cavaliere Serra : "*Prontuario dell'Artificiere per il corpo reale d'Artiglieria.* Torino, 1855."

" case-shot or Shrapnel shell", etc.,—and by this fire hastened her surrender.

An extract from the "*Constitutionnel*" (*l'Indépendance belge.*' Édition du soir, 8 novembre 1854) says : "The first parallel commonly is opened at " 600^{m} from the place; but the arms of long range " will lead to other rules. Ours will be placed " 300^{m} more this way; and yet, at this distance of " 900^{m} we shall not escape the hail of Shrapnel " shells, except by favour of the form of the soil (*)." —And, indeed, private news of the same period appear to prove that the Russians had fired Shrapnel on the French trenches, in mentioning that lumps of sulphur and bullets, sticking together, had been found in the neighbourhood of the trenches, — an inherent inconvenience of the mode of imbedding the Shrapnel bullets in solified sulphur as mentioned in Note A.

(*) La première parallèle s'ouvre ordinairement à 600 m. de la place ; mais les armes à grande portée vont amener d'autres règles. La nôtre sera à 300 m. plus en deçà ; et encore, à cette distance de 900 m. n'échapperons-nous à la mitraille des obus Shrapnel que grâce à la forme du terrain.

From the "*Journal de Constantinople*" of January 22d, 1855, the *Indépendance belge*", of February 3d, 1855, cites the following report from the French trenches : " We are so near the place " that the Russians are able to throw into our " trenches shells which, indeed, do us no harm " and bury themselves in the snow. They throw " also upon us, and that is more serious, by means " of Coehorn mortars, hollow projectiles filled with " iron bullets *à la Shrapnel,* the weight of which " is 103 grammes (3 $\frac{6}{10}$ oz. Engl.) (*). If so, the Russians even showed the intention of employing a sort of hail-bomb; but it is manifest from the results they obtained, that they had not the proper means of succeeding with this fire, *else they undoubtedly would have forced the French and the English*, — not by hail-bombs of such small, but of superior calibre, — *to blind almost all their batteries and trenches*, which, from the mentioned

(*) Nous sommes si près de la place que les Russes peuvent jeter dans nos tranchés des grenades qui ne nous font, du reste, aucun mal, et vont se perdre dans la neige. Ils nous lancent aussi, et ceci est plus sérieux, à l'aide de mortiers à la Coehorn, des projectiles creux avec des balles de fer à la Shrapnel, du poids de 103 grammes.

scarcity of wood and earth, would have been impracticable, however lightly these *blindages* might have been constructed.

English national rewards for improvement of Shrapnel and shell fire.

§ 21. — It appears, therefore, not unfair to conclude from these circumstances that most disastrous results mich have happened to the allied armies, had not the Russian Artillery, fortunately for the Allies, been destitute of the destructive military means, which a better understanding of the latest improvements in Shrapnel fire would have afforded them. In expressing this opinion, I would state my conviction, that, if such a catastrophe had befallen the British Army, the English Government would have had no reproach to make itself,—as it now, after the victorious issue of the campaign, has no reproach to make itself, because its Artillery did not profit as largely so they might have done by the superiority of this powerful fire; inasmuch as it has nobly encouraged every attempt made by its ordnance officers to improve the Shrapnel and shell fire, by decreeing to them *national rewards* more considerable than have

been ever granted by other Governments for the like purpose (*).

Inadequate estimation of the Shrapnel projectile.

§ 22.—If, up to the present day, in many countries the defective construction of the Shrapnel projectile has considerably retarded the full admission of its real value, an inadequate estimate of the extent of its application and destrustive force has tended to the same result, as may be judged from the following indications.

Some writers attribute little or no force to the splinters of the shell;—an entirely unfounded opinion, which even has led to errors in the construction of the projectile. They also give up for lost every Shrapnel striking the ground short of the mark or bursting beyond;— two accidents, which do not always necessarily render the fire quite useless.

Others think Shrapnels only efficacious when fired from guns, but of little value when fired

(*) Note H.

from howitzers and of none when thrown from mortars;—this would be the case, if Shrapnels for howitzer and mortar practice were prepared after erroneous principles. Others again limit the use of Shrapnel fire to the defence of fortified points, and do not see the immense advantage it may equally as well afford in attacking them, (as was the case at the above cited siege of Badajoz Note F).

Some would apply Shrapnels generally against troops in dense masses, deep columns, but only exceptionally against those in line and never against skirmishers (*tirailleurs*);—nevertheless this projectile is capable of rendering most valuable services in the two latter cases (battle of Barrosa).

Others pretend that for the effeetive execution of Shrapnel fire, the exact knowledge of the distance of the object is indispensably necessary, and their conclusion next following is, that Shrapnel fire can not be well employed against troops in motion.—Not only does every other projectile require the exact knowledge of the distance for accuracy

in firing, but Shrapnel rather less than common ball, common shell and oblong shot, because considerably more allowance may be made for its fire respecting errors in pointing and in the appreciation of distances. To feel the truth of this it is only necessary to consider the stretched shape and extent of the sheaf of fire formed by a well organised and well directed Shrapnel shot.

In a word, Shrapnel fire may be used with considerable advantage in all the occurrences of war, excepting, of course, battering in breach and firing against casemates and blindages; — and even in these latter cases, the incendiary hail-shell and hail-bomb may be exceptionally of greater utility than the common shell and bomb, on account of their superior weight, and of the greater mass of fire they discharge in burstiug.

The Shrapnel shell compared to the common shell with respect to its absolute weight.

§ 23. — One objection, more important in appearance than in reality, aud mainly connected with the land service, may be made to the hail-shell or Shrapnel as an explosive projectile compared with the common shell, that is, *its absolule*

weight which, as stated, is equal to that of the solid shot of the same calibre. This iucrease of weight necessarily exercises a certain influence, partly on the construction of shell-guns, howitzers and mortars and their carriages and beds, if the effect of Shrapnel fire is to be attained to its full extent, partly on the transport of ammunition in rendering it more expensive and difficult, if the very same number of projectiles should be disposed of. The increase of effect, however, is so considerable at the same time, that in reference to the first case it is well worth while to construct heavier shell-guns and howitzers, or to fire Shrapnel with reduced charges from pieces calculated for common shells; in relation to transport, the number of rounds may be diminished to an available rate and yet preserve a decided increase of destructive force compared with that which the full number of common shells would afford. The increase of efficiency more than counterbalances the increased expense for Shrapnel of a rationally founded system, the adoption of which may besides this, in partieular cases, lead to some notable simplification in projectiles, charges and tables of ranges.

For instance, for field pieces like the 12-pounder Napoleon III shell-gun and the 12-pounder Saxon shell-gun (*), the adoption of the simple and incendiary hail-shell may fully justify the suppression of the common shell (**) and limit the number of charges for incendiary hail-shell to two, the full and a feeble one.

For service on board ship, the above indicated objection is far less applicable, as may be concluded from the following reasons which, at once, show the applicability of the Shrapnel fire for naval purposes. In the first place the increase of weight due to the substitution of Shrapnel for any number of common shells, can hardly be a serious

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(*) The Saxon gun,—the invention of which is attributed to H. E. the General von Rabenhorst, the present Minister of War at Dresden and late of the R.S. Artillery,—is provided with ball, shell, Shrapnel and canister; the French with ball, shell and canister; hut as to the latter, Shrapnel also has been proposed in addition to the three other projectiles by Major (now General) Mazure. Two valuable works may be consulted on this subject viz : Ist. *Die 12pfündige Granatkanone und ihr Verhältniss zur Taktik der Neuzeit.* Artilleristisch-taktische Untersuchung von Woldemar Streubel, Lieut. im K. Sächsischen Artillerie-Corps. 1857.— 2d. *Examen d'un nouveau système d'Artillerie de campagne proposé par Louis Napoléon-Bonaparte, Président de la République;* par F. A. N. Mazure, chef d'escadron au 5e régiment d'artillerie. Paris, 1851.

(**) For horse artillery perhaps that of solid shot also.

impediment to transport at sea; in the second place shell-guns for use on board, are, according to the latest experiments, to be constructed of sufficient strength in order to endure equally well the fire with solid shot at full charge, as with shell, a principle which appears to be one of the most rational ones in naval gunnery, especially if applied with shell particularly fit for naval purposes, that is to say as thick in iron as it can possibly be made without weakening its necessary shell-power, which power, in modern times, acquires a more and more predominating character in the composition of ship-batteries (*).

These principles are already adopted by a great naval power, the United States of North America, on the proposition, and by the exertions, of Captain Dahlgren, who, in exposing their rationality and in affording to his Government the proper means for their application by the projects of his

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(*) On this subject see also the interesting memoir : "*Attaques et bombardements maritimes avant et pendant la guerre d'Orient*". Par M. Richild Grivel, Lieutenant de vaisseau. 3e édition. Paris, 1857.

iron shell-gun and of his brass boat-howitzer, has shown his great abilities as an artillerist and as a seaman (*).

On the use of Shrapnel and incendiary projectiles for naval purposes.

§ 24.—The U. S. Navy appears to have been the first to adopt regulations for the use of Shrapnel fire to some extent. General Sir Howard Douglas in his excellent work (*Naval Gunnery*, 1855, p. 425 and 1860, p. 481) recommends, indeed, to fire Shrapnel shells against troops on shore, against vessels crowded with men on the upper decks and in general wherever the *personnel* of any ship or battery may be seen, and reached; but has no confidence in the exploding power of Shrapnel, supposing it to be lodged in the solid parts of a ship, and still less in the efficacy of Shrapnel thrown from howitzers at very great elevations or from mortars; the latter fire he compares even with "Carnot's project of vertical fire with musket bullets". Considering, however, that the illustrious General, in composing his work, had in view the old English Shrapnel system, that he consequently

(*) Note I.

founded his reasonings on the same basis on which was naturally grounded the indifference of the commanding officers of the Royal Artillery under Wellington in the campaigns from 1808 to 1815 for General Shrapnel's spherical case-shot, no doubt will remain that the General could come to no other conclusion. The exact knowledge of the hail-shell system, I am sure, would have led him to form a favourable opinion of the Shrapnel fire from howitzers and mortars, for he would have seen that I have proved by it to a certainty, that the feeble velocity which may be given to these Shrapnels, is rendered very efficacious by an augmentation of the absolute weight of the balls or cylinders with which they are filled.

For the navy, as well as for any army, the hail-shell system allows a fuller application of Shrapnel fire than any other Shrapnel system mentioned in these paragraphs. The incendiary hail-shell and the hail-bomb, I hope, will justify this opinion. In the boat armament of the U. S. Navy, for instance, the Dahlgren boat-howitzer is provided with shell, Shrapnel and canister; in replacing the shell and

Shrapnel by simple and incendiary hail-shell, the efficacy of this fire may be increased, and the three tables for ranges reduced to the number of two. The incendiary hail-shell of 8, 9, 10 or 11 inches, lodged in the side of a ship, will, by its explosion, damage her as seriously as the common shell of the same calibre, though not making a breach exactly of the same size; but, if penetrating farther and bursting between her decks, it will be still more destructive on account of its greater incendiary power. The hail-bomb thrown from mortars on works on shore, not blinded, may, in a certain sense, do much more execution than the common bomb; and used against ships, bomb-vessels and even cuirassed floating batteries, will seriously endanger the operation of manœuvring them.—An interesting remark on grape shot which Captain Dahlgren makes in speaking of the fire from the Russian Steamer *Vladimir* (*Shells and shell-guns*, p. 403, 418 and 361), cannot be omitted here. He says: "We ought not to pass unnoticed the extraordinary " and most powerful use which Captain Boutokoff " made of grape. Showers of canister or grape from " mortars are commonly resorted to in the attack

" and defence of land works, but the distances " are limited, and the practice comes under the " form of vertical fire. Direct practice with grape " from shell-guns, at one or two miles, is a novelty; " and its efficiency in this case is so well authen- " ticated, that one only wonders why it was not " thought of before. The Russian and French " commanders both speak of its powerful action " on troops not likely to be checked by ordinary " obstacles." The case here alluded to is the fire on the French storming columns which on the 18th of June 1855, attempted to carry the works to the east of the Malakoff. If, on this occasion, Captain Boutakoff, the gallant Commander of the *Vladimir*, had been able to fire *hail-shell*, the French might have had to lament incomparably greater losses than those they sustained inconsequence of his grape fire.

In general, the prosecution of the Shrapnel question presents as much importance for the navy as for the army.

I beg leave to terminate these reflections with

some words on a matter of conscience, viz. *the use of incendiary projectiles.* Sir Howard Douglas says (*Naval Gunnery,* 5th edition, 1860, p. 307 and 308) : "The French, it should be observed, expe- " rienced very numerous terrific proofs of the " treacherous and suicidal effects of incendiary " and combustible projectiles in action with our " ships and fleets in the course of the late war." —" We feel deeply sensible of the atrocious cha- " racter which such a system of warfare must as- " sume, and in which we may be involved; but " the adoption of that system by us will cast no " slur upon our national character, for self defence " is the first law of nature, and the first duty of " nations".—And (*Naval Gunnery,* 5th edition, 1860, p. 311) after mentioning some cases in which ships were sunk by the fire of the enemy and their crew rescued by his boats : "But these noble and " generous impulses—these humane exertions— " far from being cherished and practised, will be " smothered and repressed in that merciless, ruth- " less, and inglorious system of warfare for which " we have been compelled, with the utmost re " pugnance and at enormous cost, to prepare.

" The black flag displayed over the depository of
" the sick, the wounded, and the dying, in a be-
" sieged fortress, is ever held sacred by the usages
" of war, as marking a locality appropriated to
" purposes of humanity. There the medical offi-
" cers—non-combatants—perform their mournful
" duties in safety; the sick and the wounded are
" no longer exposed to the casualties of war; and
" the dying depart in peace. But what shall be
" said of that inhuman system prepared for naval
" warfare, in this age of enlightened humanity,
" which would advisedly, purposely, and deli-
" berately consign the whole of these, and all
" other survivors, to indiscriminate and instant
" death or mutilation? A ship may be sunk
" in action; yet, as we have seen, there is always
" time to remove the sick and wounded, and
" save the survivors; but who shall approach a
" ship on fire to rescue her crew from the sud-
" den and awful effects of that merciless and
" barbarons system, the objet of which is to set
" fire to her at heart, and if possible blow her
" up?"—

The excellent heart of Sir Howard has dictated these lines which, being full of noble feelings, every enlightened man will concur in; but what moral difference exists between a pistol shot and a cannon shot fired at a man?—Is it less inhuman to fire at ships with red-hot shot, war rockets and common shells, than with other incendiary projectiles, the one or the other of which may set the ship on fire, or blow her up (*)? Is it humane to go under ground and crush the enemy's miner or bury him alive?—Certainly not!—The truth is, that civilization is not yet sufficiently advanced in the world for treaties between nations to be *sacredly* kept, that it is not yet possible to abolish, in their favour, the right of the stronger, and protect their right and honour by better laws, as has been done in all civilized countries in favour of families and individuals. No other hope, therefore, is left but to

(*) It is stated that at the siege of Sebastopol the English as well as the Russians, used shell and red-hot shot in the hope of setting vessels on fire. *(Letters from Head-Quaters.* March 6th, 1855. — vol. II, p. 135, etc.; and *Shells and shell-guns*, p. 352, 358. Extract from the Log of the Russian Steamer *Vladimir*, in the Harbour of Sebastopol, 1854-1855.)

defend this right and this honour to the utmost, by killing or destroying the enemy, and nobody will deny that this is a justifiable proceeding.—And England particularly ought to be satisfied if her coast-batteries and her men of war were able to challenge the enemy's ships with the words : *Keep out of the range of our guns if you do not wish to be burnt!* as such a power of her artillery would mightily contribute to defend her immense wealth; on which occasion we may quote Sir Robert Gardiner's words in his pamphlet *"Is England a military nation or not"?*—2d edition, 1857,—addressed to the members of the House of Commons : "Wealth is power, if we have power to " defend our wealth".

All artilleries carry moreover incendiary projectiles into the field. In Sweden, where the study of the art of war is cultivated with peculiar assiduity, the Academy of military sciences has even made *incendiary projectiles* the subject of a prize essay for 1858; the question is thus put : " In what " way must bombs and shells be prepared in order " to serve as good incendiary means? " — (*Allge-*

meine Militär-Zeitung, No 27 und 28 vom 3ten April 1858.)

However, notwithstanding this tendency to incendiary warfare, the civilization of our age may be said to have equally exercised its beneficent influence on the manner in which war is carried on. This influence consists in the progress of the art of war in general, but especially in the considerable improvement of our fire arms as powerful means of destruetion; for if we are notoriously superior to our enemy in that respect, we may evidently expect to bring him soon to the conviction, that wherever he seriously opposes our will, he surely will be destroyed; the natural consequence of this will be, besides our physical superiority over him, a great moral one, that is to say, we may adopt in modern warfare as a principle : *to try to obtain the desired result rather by threatening to destroy, than by destroying;* so that the inevitable sacrifices of human life in war operations may be at present considerably less than in former time on both sides. But, once in possession of such mighty means of destruction,

it evidently would be as reprehensible to use them *unnecessarily*, for the mere pleasure of destroying, as it would be to refuse to employ them for our self defence, and *thus sacrifice unnecessarily the lives of our own troops* :—a sacrifice which cannot be justified, even by the most brilliant victory.

NOTES.

Note A, page 21.

Captain Dahlgren on Artillery and the American metallic fuze.

The works of my experienced friend, Captain Dahlgren, here referred to (and some of his other writings on ordnance service) are not yet so well known in Europe as they deserve, and are of the highest interest not only for naval officers, but also for officers of artillery in general. The soundness of principle, the clearness of explanation, the simplicity and conciseness of style in these works, besides the impartiality and fairness of judgment on arrangements adopted in other countries, would inspire unlimited confidence in their author, independently of the high official position which this distinguished officer holds in the U. S. Navy and of the important missions with which his Government has repeatedly entrusted him.

Captain Dahlgren is the inventor of the new system of Shell-guns and Boat-howitzers, named after him. Several U. S. men of war, sailing- and screw-ships, are armed with these pieces.

The competency of Captain Dahlgren's judgment

on the metallic fuze is grounded on the results of experiments made under his direction as well as of others obtained in action by various officers of the U. S. Navy. His Government having made the acquisition of an apparatus for casting the case of the metallic fuze, it was Captain Dahlgren who was entrusted with the task of examining this fuze and who subsequently recommended its adoption.

The apparatus submitted to his inspection appears to have been furnished by an agent or friend of Captain Siemens of the Hanoverian Artillery; for the fuze produced in it is the very same which this officer has furnished to several European artilleries under the name of the Hanoverian or Siemens fuze, which however, is the Belgian metallic fuze insignificantly modified in its external shape. The mode of preparing the Shrapnel adopted by the American Navy is also that which Captain Siemens has proposed, viz : to imbed the bullets in solidified sulphur and to place the bursting charge in a cylindrical cavity, left in this mass of sulphur and bullets, running across the interior space of the shell and shut up with a perforated

metallic plate (*Verschluss-Schraube*) screwed into the inner part of the fuze hole (see p. 87. Boat armament. 2d edition. Plate 6. *Section of an American 12-pounder Shrapnel* and p. 89. Plate 7, *View of this projectile with the metallic fuze*).

It will be seen from Captain Dahlgren's works, that this officer is of my opinion respecting fuzes in particular and Shrapnels in general, with the exception that he has chosen the separation of the bursting charge from the bullets in the manner above described. Considering, however, that Captain Dahlgren, most probably, was not authorized to separate in his investigations the application of the two principles—that of the fuze and that of loading the shell; that he had then no knowledge of the Belgian method of loading the Shrapnel; it is not surprising, that he preferred the Shrapnel with fixed bullets to one loaded according to General Shrapnel's original plan.

Long before Captain Siemens proposed the application of sulphur for fixing the bullets in Shrapnel shells, I had tried for the same purpose the

application of clay, plaster of Paris and pitch (*); but I was soon obliged to abandon this proceeding for General Shrapnel's original plan, commingling the bullets and bursting charge, modifying, however, this mode of loading so that the bullets are no more liable to be *displaced.*

The rationality and practicability of this proceeding having been proved in Belgium by a practice of twenty nine years,—from 1833, when I was charged to make the first experiments on Shrapnel shell at Brasschaet, to this day 1862 (**),—the Belgian Artillery have never ceased to apply this mode of preparation or loading (***).

(*) See observation to § 11. Letters B, a, p. 50.

(**) From 1833 to 1835 these projectiles were fired with a fuze founded on the old principle (§ 5), and having a paper tube or case the head of which was fixed in a wooden cone. The fuze hole of the shell was provided with a second case of wood *(ampoulette)* in which in the moment of use, the fuze with its conical part was to be driven in order to fix it to the projectile (Schmœlzl. *Ergänzungs-Waffenlehre.* 2d. edition, 1857, fig. 148).—At the siege of the Citadel of Antwep, 1831, I proposed this appliance to Lieut.-General Neigre, Commander in chief of the besieging artillery, but may proposal to fire such projectiles was not agreed to, as I then was not able to present proofs of their applicability which were sufficient in the eyes of that experiencend artillerist.

(***) Last year, it was proved by the Artillery practice at Brasschaet,

If the bullets are imbedded in solidified sulphur or pitch, the projectile may answer its purpose if *freshly* prepared; but after having been in store for a certain time, it may be expected that bullets and sulphur will stick together and form lumps, which even resist the action of the bursting charge, so that the true function of the Shrapnel may be impaired. Captain Dahlgren seems to have used with success the sulphur in Shrapnel, to set fire to inflammable objects in which the projectile lodged and burst; but this purpose, I think, will in many cases be more perfectly attained by the Belgian incendiary Shrapnel (§ 18).

Note B, page 37.

Extract from the journal : "*Moniteur de l'armée belge,* n° 2, *du* 16 *janvier* 1858." Article *Artillery* on General du Vignau's memoir cited § 8.

The "*Moniteur de l'armée belge*" on Captain Breithaupt's modification of the Belgian metallic fuze in reference to General du Vignau's memoir on this subject.

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that the efficiency of the Belgian Shrapnel (Hail-Shell) fire from smooth bored 12-pounder field guns — within the limit of the range of obout 1,200 mètres (yards), — is far superior to that of the Shrapnel- and Shell-fire hitherto obtained with rifled 12-pounder field pieces of the Prussian — and perhaps also with those of any other system in use.

ARTILLERIE.

" Un article remarquable vient de paraître dans les Archives prussiennes des officiers de l'artillerie et du génie, sur une nouvelle fusée métallique pour projectile creux, de l'invention du capitaine Breithaupt, de l'artillerie hessoise.

"L'auteur de ce travail commence par l'historique de la question et rappelle les pas immenses que les études du général Bormann de notre armée et du capitaine Siemens, de l'artillerie hanoverienne, lui ont fait faire.

" Comme nous pensons que les officiers de notre armée apprendront avec plaisir en quoi consiste le perfectionnement apporté à la fusée métallique, par le capitaine Breithaupt, nous allons rendre compte le plus succinctement possible de l'article des Archives prussiennes; puis nous soumettrons à leur appréciation quelques réflexions que nous a suggerées l'examen attentif de la nouvelle fusée.

" Pour bien apprécier l'importance de l'invention

du capitaine Breithaupt, il faut se reporter à l'origine du tir des projectiles creux. La charge explosive renfermée dans le projectile était enflammée par une fusée en bois, qui, ayant toujours la même longueur, faisait toujours éclater le projectile après le même temps. Or l'introduction dans les artilleries modernes des obus à balles, ou shrapnels, entraînait avec elle la nécessité de faire éclater le projectile à un point donné de sa trajectoire, point variant avec la distance du but à atteindre et la vitesse du projectile.

"Après des essais infructueux ou peu satisfaisants, le général Bormann eut l'ingénieuse idée de placer la composition fusante, destinée à communiquer le feu à la charge, dans un canal circulaire à la partie supérieure de la fusée. De cette manière en mettant la composition fusante à nu en un point plus ou moins rapproché de l'extrémité communiquant avec la charge explosive, on fait éclater le projectile en un point plus ou moins rapproché de l'origine de la trajectoire.

" A partir de ce moment, la fusée métallique était

inventée et le tir des shrapnels devint rapidement ce qu'il est aujourd'hui, c'est-à-dire un des plus meurtriers et des plus exacts de ceux employés contre des troupes.

" La seule difficulté qui restait à surmonter était le réglage de la fusée; en effet de l'endroit où le canal renfermant la composition fusante est coupé, dépend l'effet du projectile, et pour une trajectoire dont la durée n'est que de quelques secondes, une erreur d'un millimètre devient une cause importante d'irrégularité.

" Le réglage de la fusée Bormann se fait au moyen d'une gouge avec laquelle le servant chargé de cette opération coupe le métal qui recouvre la composition fusante. Cette méthode donne de bons résultats, et pour s'en assurer il suffit de jeter les yeux sur les comptes-rendus des expériences faites au polygone de Brasschaet par les batteries de campagne pendant les dernières années; mais il est impossible de se dissimuler que l'opération du réglage ne peut être confiée qu'à des canonniers bien exercés.

" De plus, il est facile de voir qu'une fusée une fois réglée, ne peut plus servir que pour la distance pour laquelle elle est réglée, ou bien pour une distance moindre.

" Il s'agissait donc de trouver un mode de réglage tel que la fusée ne soit en aucune façon altérée par son emploi.

" C'est à la solution de cette importante question que s'est attaché le capitaine Breithaupt, et bien que son procédé n'ait pas encore été suffisamment expérimenté pour que l'on puisse affirmer que le but soit atteint, on peut dire dès aujourd'hui que la question du réglage vient de faire un progrès notable.

" Nous allons donner sommairement la description de la fusée Breithaupt, ainsi que les inconvénients que son mode de réglage peut entraîner.

" La fusée Breithaupt est faite de métal, elle se visse sur l'œil du projectile et sa construction rappelle la fusée Bormann. La partie supérieure de la

fusée affleurée par le canal circulaire rempli de composition fusante, est recouverte par une table métallique percée d'un trou circulaire à son centre et tournant librement autour d'un axe qui se confond avec l'axe de la fusée elle-même. Un second trou carré correspond au canal contenant la composition fusante, de sorte qu'en faisaut tourner la table métallique autour de son axe, on fait correspondre le trou carré à un point quelconqne du canal de la composition. Un cercle gradué est gravé sur le bord de la fusée et le réglage se fait en faisant correspondre le trou carré de la table à l'une des divisions du cercle. Enfin la table est fixée dans la position voulue par l'axe métallique autour duquelle elle tourne et qui porte à cet effet, à sa partie inférieure, un pars de vis s'engageant dans le corps de la fusée et à sa partie supérieure, qui est saillante, un entablement et un petit prisme droit hexagonal.

" On voit que pour régler la fusée Breithaupt, il est nécessaire de se servir d'une clef pour desserrer et resserrer l'axe qui maintient la table, et il est présumable que cette opération, exécutée par

des servants peu habiles, ne se fera pas toujours sans altérer le réglage. Mais cette inconvénient n'est pas le seul qu'offre la nouvelle fusée.

" En effet, la table qui recouvre la fusée à sa partie supérieure doit être serrée sur la composition fusante de manière à ne laisser de jour nulle part, sous peine de voir le tir annulé par des explosions prématurées; pour obvier à cet inconvénient, l'auteur interpose, entre la table et le corps de la fusée, une rondelle en cuir collée sur la table. Or ce palliatif, qui sera sans nul doute suffisant pour des fusées neuves, pourrait bien être illusoire lorsque, par un long séjour dans des magasins ou des avant-trains, le cuir sera plus ou moins altéré par des alternatives de sécheresse et l'humidité. D'un autre côté, l'adhésion de cette rondelle au corps de la fusée serait, par le fait, mise hors de service. Enfin, le contact du cuir avec la composition fusante pourrait également ne pas être sans danger pour la conservation de celle-ci, surtout si l'on réfléchit que la moindre altération dans la composition fusante, sous quelque forme qu'elle se produise, devient immédiatement une cause d'irrégularité.

" Les inconvénients que nous venons de signaler ne sont peut-être pas aussi graves que nous le croyons, et il est possible même que des expériences, et nous désirons vivement qu'on en fasse le plus tôt possible, viennent démontrer que le capitaine Breithaupt est réellement arrivé à la solution de la question qui nous occupe.

" Quoi qu'il en soit, nous ne terminerons pas ce compte-rendu sans rappeler à nos lecteurs que l'idée première de la fusée Breithaupt est tout entière dans la fusée Bormann, et que, sans les travaux de cet éminent artilleur, il est probable que la question des shrapnels serait encore dans l'enfance.

" Nous devons donc considérer la nouvelle fusée comme une modification de celle en usage actuellement dans notre artillerie, ou plutôt pour rendre à chacun la justice qui lui est due, disons que le capitaine Breithaupt a appliqué à la fusée Bormann un mode de réglage peut-être supérieur à celui employé jusqu'à ce jour.

" Nul doute que les expériences auxquelles la

nouvelle fusée va être soumise ne nous permettent d'établir bientôt un jugement fondé sur la valeur. Nous nous proposons, aussitôt que ces expériences nous seront connues, d'en faire part à nos lecteurs comme suite au présent article. »

Note C, p. 41.

Table comparing the successive movements necessary in making use of the fuze from the moment of the word of command to fire at a given distance, to that in which the Shrapnel shell is put into the bore of the piece, ready for being rammed home.

Table comparing some fuzes in reference to time and labour required for their application in action.

FIELD GUNS, HOWITZERS AND SHELL-GUNS.

I. The Boxer fuze.	II. The Belgian fuze.	III. The Breithaupt modification of fuze II.	IV. Time-fuze in its most perfect form noticed at the end of § 8, under letter B.
TO FETCH THE PROJECTILE FROM THE LIMBER.			
1) To open the projectile in unscrewing (by means of a key) the cap (*chapeau*) from the *ampoulette*.	—	—	—

2.) To take a fuze out of a pocket.	——	To loosen the covering disk by unscrewing (by means of a key) the central screw so much that the disk may be turned.	——
3) To find on the graduated scale (forming two longitudinally placed rows, of even and odd numbers) the point which corresponds with the distance commanded.	To find on the graduated scale (forming a circular arc) the point which corresponds with the distance commanded.	To find on the graduated scale (forming a circular arc) the point which corresponds with the distance commanded.	To find on the graduated scale (forming a circular arc) the point which corresponds with the distance commanded.
4) To place the gimlet on this point and bore through the wooden case a hole into the column of composition.	To place the chisel on this point and cut an opening into the thin part of the case which covers the composition.	To place the disk on this point and screw it down to render it again immoveable.	To place the disk on this point (by means of a pin).
5) To bore a second hole into the fire-conducting channel on the point No 2 (at the head of the row of even numbers).	——	——	——
6) To place the fuze in the ampoulette and to fix it by 2 or 3 strokes with a small mallet or with the shell against the gun-carriage.	——	——	——

7) To drive home the fuze into the ampoulette.	——	——	——
8) To uncap the fuze by pulling off the light metallic cover of the priming calice.	To open the priming chamber by scratching off (with the chisel) the thin leaden covering plate. *In some drtilleries the fuze has no priming chamber and this movement consequently is suppressed* (*).	To open the priming chamber by scratching off (with the nail) the cover of goldbeater's skin which forms the priming chamber.	——

TO PUT THE PROJECTILE IN TO THE PIECE AND RAM IT HOME.

(*) In the U. S. Navy for instance.—*Dahlgren on priming:* "There " is good reason to believe that the priming of fuzes by paste or any " other material, is wholly needless, and that the composition will ignite " quite as well as the priming,—a striking evidence of this is found in " the Bormann Fuze. When cut for use, the very minute surface of " four-hundredths of a square inch of hard driven composition, is " presented to the flame of the gun; and yet, in a very large number " that I have fired from light guns, the failures to ignite are much " fewer than the best primed fuzes freshly prepared. Originally, the " inventor made use of a central priming, but it proves to be unneces- " sary, and has been dispensed with. The objection to priming of " any kind is its exceeding suceptibility of moisture, and its destruc- " tion by dampness, which would not affect the smooth, hard surface " of the composition." *(Shells and shell-guns.* Page 147.)

In Belgium the metallic fuze II is primed, but the priming chamber is *not* in communication with the prism of fusing composition. The only difference between the fuzes II and IV, therefore, is in these two

cases, that fuze II requires the operation of cutting it open and fuze IV not, as stated under No. 4—II and No. 4—IV, of the above table.

Observation 1st.—In the cases I, II and III, the projectile may be put into the bore of the pieces before the preceding movement No. 8 of uncapping the fuze be executed, which perhaps may be desirable in heavy rains.

Observation 2d.—The price of the fuzes may be estimated as follows:

1000 fuzes of No. II, francs 350.00 or £ 14-0-0..... { Instruction sur le matériel de l'artillerie belge.

1000 fuzes of No. III, { from fr. 729.20 to fr. 937.50 } or { from £29-3-2 4/10 to £37-18-0 } { General du Vignau's memoir.

1000 fuzes of No. IV as much as those of No. III or a little more.

1000 fuzes of No I, { from fr. 2500 to fr. 3000 } or { from £ 100-0-0 to £ 120-0-0 } { Colonel Delobel's *Revue, II.*

Since the introduction of rifled guns, cheapness has lost something of its influence on decisions which Governments have to consider respecting the adoption of projectiles and especially of fuzes, because their importance has been more correctly appreciated than but a few years ago. Prevention of waste in these parts of ordnance stores as well as in others, however, will always be a wise measure.

Observation 3d.—It should be remarked here, that it may be advantageous to have two patterns of fuze II, one for *shells* destined to be fired from guns, shell-guns and howitzers, the other for *bombs*, properly so called, to be fired from mortars (under high elevotions, of 45° or more).— According to general usage it is expedient to make this difference between shell and bomb, inasmuch as it avoids the confusion arising from including these two projectiles under one and the same denomination of *shell*, as in England or of *bomb*, as in Hanover; but it is msreover incorrect in Paixhans, to call his shell-guns or rather long howitzers "*Canons à bombes*" and the shells for these pieces "*Bombes*", as in France, the difference in question is really made between "*obus*" and "*bombe*".

Note D, p. 43.

U. S. Ship Plymouth.

Shanghai, April 4th 1854.

American *Report* on an engagement in which the metallic fuze was used in action against a body of Chinese Imperialists.

The lives and property of American and British citizens having been frequently endangered by the wanton proceedings of a body of Chinese Imperialists, encamped about Shanghai, which were persevered in, notwithstanding the representations of Captain Kelly, U. S. N., and Captain O'Callaghan, R. N., it was agreed by them to co-operate in abating the nuisance. To this effect, these officers, with the Consuls of their nations, made a formal request to the Chinese commander that he would cause the post to be peaceably evacuated, and notified to him their intention to enforce this request, if not otherwise complied with. No answer being received, there were landed, in the afternoon of the 4th of April, about 60 seamen and marines, with a 12-pdr. howitzer, in charge of Lieut. Guest, from the Plymouth, and 150 men from the British vessels "Encounter" and "Grecian".

These being joined by volunteers from the residents of Shanghai, with two private fieldpieces, and 30 seamen from American merchant ships, the attack was commenced by Captain O'Callaghan, on the right of the entrenched camp, and by Captain Kelly on the left, who, about 4 P. M., directed a fire to be opened from the light artillery of his party.

Lieut. Guest, of the Plymouth, speaking of the U. S. 12-pdr. boat howitzer, which was under his charge, and personal direction, says : —

" Shell, shrapnel, and canister were fired with great effect, perhaps to the number of 40 or 50 rounds."

" The fixed ammunition was perfect; not a single shell failed to burst, not a fuze or a tube disappointed us; and, consequently, the officers and men were inspired with perfect confidence in the gun, both as a means of assailing the enemy and of defence when attacked."

" The graduated fuzes so plainly marked from 1 to 5 seconds, enabled us to drop our shells

exactly in the spot intended, and the precision with which it was done, in comparison with all other artillery which we had seen fired, was a subject of gratification and surprise."

"With the canister, we raked the top of the Chinese breastworks, and drove back a very large force, which advanced against us in the field. We found the gun as well adapted to canister as to shell or shrapnel."

Captain Kelly states, in his official Report, that after firing 15 or 20 minutes from the light artillery, the men were led forward, much exposed to the musketry and wall-pieces of the camp. Very soon the Chinese were routed, with some loss; and the next day the entrenchments were levelled, which terminated the annoyance.

The Americans and English had two seamen killed and six wounded. Mr. Gray, the chief clerk of a commercial house, lost both of his legs; and Captain Pearson (of an American merchant ship) was mortally wounded. (Dahlgren. *Boat armament of the U. S. Navy*, p. 162.)

Note. E, page 66.

An effect similar to that of Shrapnel fire exhibited by nature.

To judge from the following statement which I found in the Cologne newspaper *"Kölnische Zeitung,"* 14th of November 1850, it would appear that Nature herself first exhibited the Shrapnel fire :

" *Ellen Anna,* Bristol Channel. Cloudy weather
" fresh gale. Noise of thunder. Four planks were
" found disjoined on her deck and partly pierced
" as if shot through by musket bullets, and the
" holes, three inches deep, bored so that the bullets
" seemed to have been fired vertically down from
" the clouds. The borders of the holes were more
" or less singed. A meteoric stone had burst and
" bombarded the dek. Such phenomena are said
" to be not rare in the Mediterranean, but till now
" unknown in the nothern seas (*)".

(*) *Ellen Anna*, im Bristoller Canale. Trübes Wetter; frischer Wind. Polterartgies Getöse. Man fand, dass 4 Deckplanken ans den Fugen gerissen und stellenweise wie von Flintenkugeln durchbohrt waren, und die Löcher 3 Zoll tief, waren so gebohrt, dass die Kugeln senkrecht ans den Wolken herabgeschossen zu sein schienen. Die Ränder zeigten sich mehr oder weniger versengt. Ein Meteorstein

It is to be regretted that no notice has been given respecting the fragments of this meteoric stone, which must have been found on board the Ellen Anna. There is no reason to doubt the actual occurrence of this phenomenon, as our greatest philosopher Alexander von Humboldt, in his *"Cosmos,"* in treating of meteoric stones (Meteorsteine), adduces instances of their bursting and scattering their fragments over the ground. (*Kosmos,* 3ter Band. Stuttgart und Tübingen 1851, p. 610.)

Note F, page 69.

Effects produced by spherical case-shot at the last siege of Badajoz and at the battles of Barossa and Waterloo.

These letters are from British officers, the first from General Sir Robert Gardiner, G. C. B., Royal Artillery, late Governor of Gibraltar, one of the most honoured veterans of the British Army, the second from Captain Townsend, late Royal Horse Artillery, who both fought gallantly in the wars from 1808 to 1815 in the Peninsula and at Waterloo.

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war geplatzt und hatte das Deck bombardird. Solche Erscheinungen sollen im Mittelmeere nicht selten sein, in nordischen Gewässern bisher noch nicht bekannt.

I.

"Claremont, October 6th, 1848.

"My dear Bormann,

" I can have no hesitation in giving you my opi-
" nion on the use of Shrapnel's shells—I think
" they have a higher reputation in theory, than
" they deserve from their effect in practice—this
" I will endeavour to explain—without any preju-
" dice against them as a most destructive projectile
" in certain cases of service—but still retaining my
" preference in general cases of service, to round
" and grape shot.

2. " I became doubtful as to their unqualified
" merits, at the commencement of the Peninsular
" war—and almost from the beginning of that ser-
" vice, I always preferred making my demands for
" the replenishment of expended ammunition in
" round and grape shot, with but a comparatively
" small proportion of Shrapnel—and this I should
" certainly do, if I was in the field to-morrow.—

" Nothing, be assured, is so destructive as the sim-
" ple round and grape—with few exceptional in-
" stances of service.

3. "I was called on during the Peninsular cam-
" paigns, to give my opinion on the merits of Shrap-
" nel's shells—which I did in an official report to
" the purpose I have mentioned. Once in a way,
" they tell with terrific effect—but either the ge-
" neral hurry and excitement of action, or some
" casual cause prevents that certain, constant, in-
" variable accuracy which should always mark the
" fire of efficient artillery—and which, as I think,
" can alone be always depended on, in the use of
" round and grape shot, with well instructed and
" well practised artillerymen.

4. "I am more partial to Shrapnel when in po-
" sition, or when stationary (such as the opera-
" tions of attack and defence in sieges), than in
" the shifting movements and constantly varying
" ranges of field service.—I will mention two
" instances under such circumstances, in which
" they did good service.

5. "The first occurred during the last siege of " Badajoz.

6. "Our batteries directed against the intended " flank and main breach, were excessively galled " by the fire from the south flank and face of the " St.-Pedro Bastion.—It soon became our object, " of course, to enfilade and silence this annoyance, " but neither round shot or common shells, " though plunging in ricochet and exploding over " the Bastion, could do it. At last we resorted to " Shrapnel—and that silenced our friends very " soon.

7. "On the fall of the place, I went to the spot, " to examine and ascertain if any traces of the ef- " fect of our fire remained.

8. "I found the left cheek of every gun carriage " in the enfiladed flank of the Bastion perfectly " riddled with balls from our Shrapnel. In fact " I don't think they fired half a dozen rounds " from this point, from the time our enfilade " began. No man, indeed, could stand to the " guns under such a shower of balls.

9. "The other instance I had in view to mention
" was in the battle of Barrossa.

10. "In the battle of Barrossa (in 1811) the
" whole of the English Artillery were massed in
" advance to cover the deployment of our columns.

11. "During the deployment, the enemy was
" advancing in line, his front covered by nume-
" rous riflemen and light troops, but at too great
" a distance for our employment of grape or ca-
" nister. The Shrapnel shell here was most ad-
" vantageously employed and did great execution.

12. "On these two occasions, I speak from
" personal observation. But I should say also
" that I consider Shrapnel as a projectile highly
" destructive if efficiently employed against troops
" advancing in boats to escalade the sea line of
" any fortress. For this purpose, I should cer-
" tainly use them till the boats had advanced
" within range of grape and canister.

13. "There are few officers now living, who com-

" manded Troops or Brigades of artillery in the
" battle of Waterloo—and without personal refe-
" rence to officers in command, I could scarcely
" answer your questions as to the extent of em-
" ployment of Shrapnel on that day. — But for
" obvious reasons I should say it was not so gene-
" rally employed as round and grape shot.

14. " The enemy's columns advancing against
" us, would naturally be first saluted with round
" shot, till they came within grape shot range. As
" you are aware, the enemy's cavalry were unsuc-
" cessful in their efforts to break our squares.
" These troops on retiring from their ineffectual
" attempts, suffered greatly from our artillery
" fire, which, judging, from my own partiality to
" that nature of shot, must have been grape. They
" did not, of course, linger in their steps—and
" though acting with consummate bravery, a mi-
" nute's space of time conveyed them to a distance
" which suggested a change of fire from grape to
" round shot.

15. "In the foregoing remarks, you will, I think,

" be enabled clearly to discern the reasons which " influence me in my opinion on the Shrapnel " shell—and my predilection in favor of more " simple and certain projectiles. I must, however, " to give you a fair answer to your question, tell " you, that many officers of artillery have different " opinions to my own, on the merit of the Shrap- " nel shell. I only offer you my own opinion. " And certainly if I was equipping artillery for " service under my control, I should, as I have " said, require but a limited proportion of Shrap- " nel, comparatively with that of round and grape- " shot.

" Believe me, my dear Bormann, most faithfully yours.

(*Signed :*) Robert Gardiner."

This judgment is a most valuable and rational one and quite conformable to the condition in which spherical case-shot was in England during the forty years from 1808 to 1848. The German artillerists in general were of Sir Robert's opinion and con-

sequently hesitated, as mentioned in § 16, to adopt this projectile in their armament before the fuze question was more satisfactorily resolved.

II.

" Dear Colonel Bormann,

" Since our conversation upon the *use* of Shrap-
" nel shells at the battle of Waterloo, you will
" recollect at that time I assured you that they
" *were used* at the battle and with *very conside-*
" *rable* effect both at the wood and orchard of
" Hougoumont as also upon *masses* of Jerome's
" attacking columns. This assertion has been fully
" confirmed by my friend Lt.-Colonel Louis of the
" R^{l} Horse Artillery, now commanding that corpos at
" Limerick in Ireland, he is, excepting myself, the
" only surviving officer of the late Colonel Bull's
" Troop to which we were attached at that battle.
" Colonel Bull had received orders to exchange
" our nine-pounder guns for those of heavy 5$\frac{1}{2}$-inch
" howitzers which, as you are aware, are fully
" adapted for the use of these shells. Our posi-

" tion was immediately upon the high ground
" commanding the wood and orchard of Hougou-
" mont, where we were stationary during the whole
" of the battle, and I perfectly recollect our going
" to the 2*d* line to replenish our ammunition, the
" waggons of which were, of course, stationed in
" a comparatively sheltered spot and where we
" *prepared* the *fuzes* for Shrapnel shells. I can
" bear in mind most *fully,* how efficacious they
" were both in *clearing* the wood of Hougoumont,
" as also in the *chasms* made in the French at-
" tacking columns which advanced in *great* masses
" upon Hougoumont. I could in several instances
" bear in mind the *devastation* caused to the
" French infantry by the bursting of these shells,
" some of which burst *beautifully* (if I may use
" such an expression in killing *mankind*) in the
" air, spreading death and destruction *very* visibly
" to my *eyes.* My friend Lt.-Colonel Louis says in
" his letter to me :" "You may assure Colonel Bor-
" "mann that *Shrapnel shells* were *used* at the
" "battle of Waterloo and by our Troop, and I
" "also remember what execution we did with
" "them, in the case of Jerome and d'Erlon's corps,

" "added to the affair of the wood, which, as you
" "remark, was *beautiful* practice." "Thus you
" will perceive there can be no longer a doubt of
" Shrapnel shells being used at the battle and
" that, as before stated, with *very considerable* ef-
" fect, and I think, I have made myself clear upon
" this subject, that is, if you can *read* this *scrawl*,
" for I am writing hastily, but do not wish to de-
" fer the subject, as I have already done, to a la-
" ter period than I had intended. Etc.

" Believe me yours very faithfully.

(*Signed :*) JOHN TOWNSEND."

"*Hôtel de Belle-Vue* (*). February 24th, 1849."

Of the facts to which these two valuable testimonies refer, the first is already substantially known from several publications on the Peninsular war; not so is it with the last. Till now, at least, and as far as I know, no military author has ever men-

(*) Brussels.

tioned that French troops at the battle of Waterloo were killed or wounded by the fire of spherical case-shot. It, therefore, may be well supposed, that eyewitnesses who commanded in the French Army, not knowing the principle on which the spherical case-shot was founded, attributed the wounds inflicted on their men by this fire, partly to splinters of common shells, partly to the fire of the English Infantry and Riflemen, who particularly distinguished themselves at the point of the battle, alluded to by Captain Townsend and Colonel Louis.

NOTE G, page 69.

The English policy formerly dopted respecting the use of shell-power for naval purposes, —not applicable to that of the Shrapnel projectile in the late Crimean war.

It cannot be admitted that the British Government purposely neglected the spherical case-shot, as it formerly purposely ignored the shell, avoiding the development of this projectile as a needless addition to its naval superiority already sufficiently established, as Captain Dahlgren states "*Shells and shell-guns*" in citing, p. 10, the following remarkable passage from a much esteemed English author : "So long as the maritime powers, " with which we were at war, did not innovate

" by improving their guns, by extending the inven-
" tion of carronades, or, above all, by projecting
" shells horizontally from shipping; so long was
" it the interest of Great Britain not to set the
" example of any improvement in Naval ord-
" nance, since such improvements must eventually
" be adopted by other nations; and not only would
" the value of our immense material be depreciа-
" ted, if not forced out of use, but a probability
" would arise that these innovations might tend
" to render less decisive our great advantages in
" nautical skill and experience. Many of the de-
" fects which were known to exist, so long as
" they were common to all navies, operated to
" the advantage of Great Britain". — (*Simmons*,
" page 2.)

This policy respecting shell power, may be deemed very wise, because it had the desired effect; but how then. if the contrary had been the case? — And this might easily have occurred, if the French Artillery, at that period, had perceived the real value of that simple appliance, the fuze; for this discovery would soon have led such experien-

ced artillerists to the appreciation of the immense power of a duly mastered shell fire, which, in part at least, might have been used immediately in the course of the war, by merely substituting for their old wooden fuzes, more carefully driven ones of the same construction.

To this sort of policy,—always a hazardous one —an *accomplished* artillery has hardly need to resort; for if it be not advisable to publish all that is in course of experiment or to impart secrets of this kind to foreign visitors without being assured of their discretion, a state possessing such an artillery may confidently make use of any superiority of its ordnance power, as its artillery officers will never be at a loss to establish a certain superiority on other points of their sphere of activity, if the enemy should chance to profit by the lesson thus received. But this is not always easily done, and certainly was not to be expected during the Crimean war, with respect to an improved Shrapnel system; the Russians would not have had time enough to acquire the necessary practice in its application.

Note H, pages 90 and 96.

French Shrapnel fire at the battle of Traktir bridge. — English national rewards for improvement in shell and Shrpanel practice.

a.) Delobel. *Revue de technologie militaire.* T. II, p. 332.

" Chose bizarre! il y a plus d'un demi-siècle que " l'artillerie anglaise a inventé et adopté l'obus à " balles; qu'elle l'expérimente de toute façon et " l'applique à toute espèce de bouches à feu; " qu'elle en réglemente l'emploi par des tables de " tir sans fin, sans nombre et d'une complication " telle que les 3/4 au moins des données de ces " tables ne pourraient jamais avoir d'application " utile à la guerre; qu'elle en améliore et change " incessamment les fusées, depuis celle proposée " par l'auteur de ce projectile jusqu'à celle inven- " tée en 1852 par le capitaine Boxer et qui vient " de valoir à cet officier une récompense nationale " de 125,000 francs; et malgré tout cela, qui donc " a entendu mentionner particulièrement les ef- " fets des shrapnels anglais dans les combats de " Crimée? tandis, au contraire, que l'artillerie " française, qui ne connaît pour ainsi dire les

" shrapnels qu'en théorie; qui ne les avait encore
" adoptés qu'à titre d'essai pour son petit obusier
" de montagne, et qui, même pour cette pièce,
" avait presque renoncé à leur emploi; l'artillerie
" française, disons-nous, a trouvé au pont de Trak-
" tir l'occasion de produire sur les Russes en re-
" traite un magnifique effet avec les quelques
" shrapnels de 12c. qu'elle avait mis dans ses
" coffrets sans y avoir très-probablement attaché
" beaucoup d'importance. Et quant à l'artillerie
" russe, s'il était vrai, ainsi que les gazettes l'ont
" rapporté, que parmi les shrapnels qu'elle a tirés
" du haut des remparts de Sébastopol, il s'en
" trouva qui n'étaient que de gros boulets creux,
" remplis de balles en fonte, on comprendrait
" parfaitement que les assiégeants n'en eussent
" guère remarqué les effets, attendu que de pareils
" projectiles ont inévitablement dû éclater à tout
" coup dans l'âme de la pièce."

b.) General von Decker : "*Die Shrapnels*". Berlin, 1842, page 9, in an extract from a biographical Article inserted in the *Naval and Military Gazette* of March 19th 1842,—of which I was not able

to procure a copy,—makes the following remarks on General Shrapnel. "Bald nach der Belagerung " von Gibraltar (?) machte er die Erfindung der " Granatkartätschen, welche noch heute seinen " Namen führen. Die Entdeckung wurde für so " wichtig erachtet, dass bei deren Einführung " in die Artillerie dem Erfinder eine lebenslänglich Pension von 1200 Pfd. Sterling neben dem " Gehalt seiner Charge zugestanden ward. Wenn " er diese Pension von 1803 bis an seinen am 12 " März 1842 zu Southampton erfolgten Tod bezogen hat, so kostet die Erfindung der Krone " England nicht weniger als 46,800 Pfd. St. oder " 327,600 Thaler.—General Shrapnel verliess den " aktiven Dienst den 29. Juli 1825 als General-" Major, wurde also erst nach seinem Ausscheiden " zum General-Lieut. befördert."

c.) Terquem and Favé, in their often cited work : "*Les expériences sur les Shrapnels*". Paris, 1847. p. VII, observe with reference to the foregoing notice : "La note suivante que nous donnons, d'après " Decker, fait voir comment le gouvernement an-" glais sait rémunérer les services rendus au pays."—

"Shrapnel a fait la campagne de Flandres sous le " duc d'York et a assisté au siége de Dunkerque " en 1793. On dit que c'est peu après le siége de " Gibraltar, qu'il eut la première idée de son pro- " jectile; elle fut jugée si importante, que lors de " son introduction (en 1803) dans l'arme, on accorda " à l'auteur, outre ses appointements, une pension " viagère de 1,200 liv. sterl. (30,000 fr.). Il quitta le " service actif le 29 juillet 1825, il fut nommé lieu- " tenant-général après sa retraite; il est mort le " 12 mars 1842."

Note I, page 102.

Dahlgren Shell-gun and Boat-bowitzer, — sufficiently strong to fire Hail-shell or any other kind of Shrapnel shell.

The following passage from *"Shells and shell-guns"*, p. 410, particularly refers to the principle in question :

" If then the employment of ships to batter the " solid masonry of shore works is so rare, that it " should be regarded as really an exception to the " general rule of their service, which is the attack " of wooden structures like themselves, then it " seems to follow that naval ordnance should cor-

" respond in its character to these purposes, and
" be adapted to shells rather than to shot; with
" the endurance, however, competent to discharge
" the latter if an exigency should arise. And
" these views have governed in the armament of
" the United States screw frigates (*Merrimac* (*) and
" class) recently built; the new ordnance of which
" has been well proven to be able to fire a greater
" amount of solid shot than have ever been appro-
" priated to guns intented for that service only."

The construction of the Dahlgren shell-gun is not given in the works of Dahlgren which I have cited, but a sketch of a 9 inch (0m.22) gun of this kind has been recently published in an able report on the armament of the U. S. Ordnance ship "Plymouth", made by a Dutch Inspector of artillery, M. de Fremery, to his government on occasion of her touching at Amsterdam in 1857, under the command of Captain Dahlgren himself (*Rapport omtrent het Artillerie-Materieel van de Noord-Amerikaansche*

(*) The *Merrimac* visited England in 1856. — See *Illustrated London News* for October 1856.

Oorlogs-Korvet Plymouth. *Uit de Verhandelingen en Berigten betrekkelijk het Zeewesen,* etc., 1857, nº 4, 2e Afd.). This shell-gun inspires the greatest confidence as to its capability of resistance in firing solid shot and consequently also in firing hail-shell or any other Shrapnel. M. de Fremery plainly, though indirectly, confirms this opinion in his report; he also fully approves the views of Captain Dahlgren respecting the boat armament of the United States Navy (*).

(*) "Page 3. — De groote duurzaamheid en het groote wederstand-
" biedend vermogen van deze kannonnen, moeten worden toegeschreven
" aan de grootere metaaldikte rondom de buskruidlading en aan de meer
" doelmatige verdeeling van het metaal over den geheelen vuurmond;
" omstandigheden, welke ook in het oog gehouden zijn, bij de latere
" vuurmonden van onze Marine, die in dit opzigt, tot nu toe, weinig te
" wenschen hebben overgelaten."—And Page 12. — Tot de meest be-
" langrijke zaken aan boord van een oorlogschip, in den waren zin des
" woords, behooren voorzeker ook de sloepswapening en de middelen
" tot het doen van landingen. Deze zijn bij de Noord-Amerikaansche
" marine, door de vrijgevigheid der regering en door de zorg en over-
" moeide inspanning van DAHLGREN, tot eene groote mate van vol-
" maaktheid gebragt."

APPENDIX.

APPENDIX.

I. To § 9 (p. 42). *Use of the metallic fuze in action.* —The regular and normal explosion of the Hanoverian Shrapnels—or action of the metallic fuze,—in the Schleswig-Holstein war of 1848 and 1849, has equally been remarked by a competent eye-witness of the Danish Artillery, who commanded in a position opposite to the Hanoverian batteries; but as to the efficacy of the bullets which these projectiles contained, his opinion differs from that which the Hanoverian officers had formed on this subject. The characteristic words of my friend's statement in that respect are: "After the explosion " of the Shrapnel, it appeared as if its bullets had

" lost their onward movement and fullen to the " ground without being animated with sufficient " force to hurt,"—a circumstance he ascribes to the manner in which the bullets were imbedded in solidified sulphur.

The Hanoverian officers, of course, not having had the same facility of ascertaining the effect of these Shrapnels and judging only by the fact of the normal explosion of the projectile respecting its time of flight, were fully entitled to admit, in this particular case, an excellent execution so much more readily, as on other occasions in the very same war, such a result had been visibly obtained. Both parties, therefore, may be in the right and we also in inferring from these facts, the necessity of constructing not only the fuze, but also the other parts of the system according to rational principles.

II. To § 17 (p. 73). *Use of Shrapnel shells against Sebastopol.* — In the work : "*The Story of the Campaign of Sebastopol*" written in the Camp by Lt.-Col. E. Bruce Hamley, Captain, Royal Artillery,

Edinburgh and London, MDCCCLV, we find the following passage, page 278;—"On the 20th (July " 1855), some rockets from the advance of our right " attack fired the Karabelnaia suburb, situated " behind the Malakoff, which consists of a great " number of small houses adjacent to, though not " adjoining, each other, in which the troops for the " defence of this part of the Russian works reside. " When the alarm of fire was given there, a great " number of soldiers thronged out in disorder, and " a multitude of carts made their appearance. At " first only one of our guns bore on the crowded " space between the houses, from whence the " troops attempted to pass towards the Malakoff " after each discharge. By widening an embra- " sure, a second gun was brought to bear on them " with spherical case, and proved very destructive " —prostrate men, broken carts, and runaway " horses marking its effect. The fire continued to " burn all day, and destroyed several houses, and " others were frequently set on fire afterwards " by rockets, while the guns continued to enfilade " the streets of the suburb whenever a few persons " were visible."

This statement being the *only one* in the whole book respecting spherical case-shot, I think myself entitled to maintain the conclusion : that the Shrapnel fire of the Royal English Artillery, if,—with the exception of the fire against the Redan mentioned in § 17,—anywhere else applied in the Crimea, was deemed of no more importance than that of their common shell. Admitting even, that Colonel Hamley, as an officer of artillery long accustomed to Shrapnel practice, laid no particular stress on the effect produced by this projectile, the above conclusion appears to be tacitly confirmed by several other passages in which this officer mentions some extraordinary effects of common shell fire of which he was a close eyewitness. And, indeed, if some distinct details on the use of English spherical case-shot were to be expected anywhere, it certainly was in this well written, valuable work.

III. To § 15 (p. 61).—*The German Hagelkugel.*— Extract from the *Codex palatinus*, which Professor C. R. Sachse of the Heidelberg University had the kindness to verify :

"Univ. Bibiothek Heidelberg.

"AUSZUG

aus dem *Codex palatinus,* N° 258.

(Blatt 32 und 33.)

F. " mag auch nicht ain Hagel gemacht werden der gantz vom Rohr fert und sich erst vber ettlich hundert Schrytt nachet oder feer wie man will von ainander geht vnd sich austhailet.

B. " Solliches ist gar schwerlich vnd mit grosser müheselligkhait ins werckh zu richten jedoch moglich aber nit wie ettlich ausz vnverstandt ohn alle erfahrung davon geredt vnd geschryben haben. man soll den Hagel in ain Blayen Zarg ainmachen die zu hinderst ain boden miden in demselben ain Loch dasz man ungevährlich ain fünger hineinstoszen mag vnd ain hülzen rohr hinden bei dem zugemachten Loch ain boden hineingestoszen. bis auf halben Thail durnach neben dem rohr soll die

"Hagel Kugel die sich über ettlicht hunderd schritt aufthuet. "

Zarg mit röschem puluer ausgefüllt werden vnd ungeuärlich ain Zwergfünger hoch über dasz rohr darnach den dem Hagel darauf hinein setzen geheb vnd satt. dasz rohr soll man mit schwachen Raggetten oder angefeuchtem Zeug ainfüllen vnd zuvorderst mit Zündtpuluer aingerungt vnd also in dasz Stuckh auf dasc Puluer hinaingeladen vnd gestossen. So zündt sich d. Zeug im Rohr vom schusz an vnd fehrt der Hagel also gantz vom Stuckh vndt bleibt bei aynandter bisz der Zeug im Rohr auszbrynnt bisz auf dasz Puluer. Alszdann zerschlag in erst dasz Puluer so dahinter ligt vnd gedh von ainander solliche Speculatation haben vil gehabt aber im Werckh und in der prob hats in grob vndt wait gefellet. dergleichen Exempel hab ich ver uelcher zeitt selbst gesehen dasz sich ain sollicher Hagel im Stuckh angezündtt vndt gleich vor dem Stuckh zersprungen vnd in boden gangen. Und hat der Teufel ain Gaugelspiel angericht. wo nicht dasz Glickh sonderlich dabei gewesen dem Maister disz werckhs darzu den Ohrt ich hie zu nennen verschone. die ursache aber zu versuchen warumb sollicher Hagel selten guet thue sondern gemaniglich im Stuckh angangen und zersprungen mag

khain anderer erfundten werden, dann dieweil die Zarg vom Schusz also hefftig wiewol zu gedenckhen erhützíget würt auch in sollicher Hütz dasz Puluer darin verschlossen entzündt vnd zersprüngt alsbald den Hagel ehe er recht ausz dem Stuckh khümbt. zum andern mag auch der Zeug im Ror von der gewaltigen groszen Resolution des Puluers im Fewer so da hinden geladen würt verhützíged werden dasz es sich auff ainmal anzündt sambt dem Puluer darneben im hinderen midel der Zarg ligt. durch disem Irsal sich sollicher Hagel aufthen zerspringen würt ehe er recht ausz dem Stuckh khombt. Willt du aber dasz es guet thue vnd khaine gefar darbey zu besorgen sey mustu die Zarg inwendig mit dynō Laimb füttern darzu dasz rohr fleyszig mit dem Zeug füllen vnd zuvorderst auf dem Zeug ain Rummen sat auf dasz Puluer ain Stuckh hineinsetzest wie sich geburt (*) ".

(*) It is to be regretted that this manuscript did not come under the notice of the Emperor Napoleon III, in order that a fact so important, in relation to the history and progress of Artillery in the sixteenth century, as the knowledge, in that age, of the *Hagelkugel* — might have been taken into consideration in the valuable notes of His Imperial Majesty published in the work entitled — "Etudes sur le passé et l'ave-

The meaning of this document, I think, may be rendered pretty nearly with all its repetitions, as follows :

Fewerwerkher (Artificer).— "Morover, may not a kind of hail be made which rushes entire from the piece, and discloses and spreads itself only at some hundred paces, nearer or farther, as one may wish?

Büchsenmaister (Artillery officer).—"That is to be carried into effect with great difficulty and toil, yet it is possible; but not as some, from want of knowledge and without any experience, have talked and written about.

" Hail-shot which discloses itself at some hundred paces "

"The hail is to be packed up into a leaden case (*) having behind, in the middle of its bottom, a hole in which about a finger may be introduced and

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nir de l'Artillerie. Ouvrage continué à l'aide des notes de l'Empereur, par Favé, Colonel d'artillerie, l'un de ses aides de camp. Tome troisième (Histoire et progrès de l'Artillerie). Paris. 1862. "

(*) *Zarg. Sarge*—a round inclosure, a case (Capt. Toll). Most probably this case was of cylindrical form, though later than 1573, *Hagel-*

which is to be shut up with a wooden tube (*). Then, up to its middle, round the tube and about a finger's breadth above it, the case is to be filled with rash powder (**) on which the hail is to be put sufficiently settled.

"The tube is to be charged either with slow rocket or moistened composition and primed at its head (***), with which it is to be introduced into the piece and rammed on the powder (****).

"Thus the composition in the tube catches fire from the flame of the piece, the hail, therefore, rushes entire from it and remains together until the composition in the tube is burnt out to the bursting charge. Then only, the hail is broken by the powder lying behind it, and spreads itself.

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kugeln of oval shape appear to have been also used in Germany, the bursting charge of which was placed in the centre of the mass of hail.

(*) Fuze — no doubt of similar construction as the fuze of 1632, mentioned p. 26.

(**) *Röschen puluer*— rash (grained) gun-powder, in opposition to slow (mealed) powder?

(***) *Priming powder*—rammed in at its fore end.

(****) Charge of the piece.

"Many have made such a speculation, but failed grossly and widely in its arrangement and trial. Examples of this kind I lately saw myself : the hail caught fire within the piece, burst immediately before it and went into the ground; and, as bad luck would have it, the Devil played a trick and slew (*) the master of the work into the bargain. The place (**) I forbear to name here.

"In searching, however, for the reason why such hail seldom succeeds, but commonly catches fire and bursts within the piece, no other can be found than this : the case, as may be imagined, is intensely heated from the charge of the piece; such a heat fires the powder within it, and the hail bursts forthwith before it rightly comes out of the piece. Secondly, the composition in the tube, also, may be heated by the great, vehement solution in fire of the powder which is loaded behind it (***), so that it catches fire at once together with the pow-

(*) Verb wanting in the text and supplied by Capt. Toll.
(**) Where this happened.
(***) Charge of the piece.

der surrounding it in the case (*), in consequence of which *error* such hail will often burst before it rightly comes out of the piece.

"But if you wish all to go well and no danger to be apprehended therefrom, you have to line the inside of the case with fine clay (**); to drive the composition well into the tube, ram in priming powder at its fore end and push it into the piece on the powder sufficiently, as it ought to be."

Another passage of this manuscript, preceding the above citation and speaking of *different sorts of hail, shut up in leaden boxes and fired,* adds : " which was with our ancestors a great art and

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(*) Bursting charge.

(**) In the text it is said : *thin clay;* but, evidently, fine, consistent clay is meant, such as is used in our days to clay war rockets.

secret."—These words seem to imply, that the principle of the *Hagelkugel* is of still earlier date than the manuscript itself.

After the taking of the town of Heidelberg by Tilly in 1622, Duke Maximilian of Bavaria, considering the University Library as fair booty, presented it to Gregory XV, in consequence of which donation, it was carried to Rome in 1623, where it formed part of the library of the Vatican under the name of the "Bibliotheca palatina". In 1815, however, on the conclusion of the peace of Paris, the Pope, at the instance of the Austrian and Prussian Governments, was compelled to restore to Heidelberg this literary treasure comprising 847 old German manuscripts, of which that of Samuel Zimmermann was one. It is evident, that the absence of this manuscript from Germany for nearly two centuries is sufficient, independently of other reasons, to account for the oblivion into which the *Hagelkugel* had fallen amongst the Germans.

VI—*A glance at the present state of the Shrapnel question in England.*

When the first Edition of the foregoing Sketch was published in April 1859 (*), I was not aware of the progress the Shrapnel question had already made in England, concurrently with the introduction of the Armstrong rifled guns into the British Ordnance Service. All that concerned these guns was concealed from the public and considered as a state secret, until the private interests of the inventor M. William G. Armstrong,—now Sir William G. Armstrong, Superintendent of Royal Gun Factories,—were guaranteed by the Government's acquisition of the patents he had previously taken out for different parts of this new system of ordnance. Soon afterwards, however, the fact became well known that this system included a Shrapnel Shell (*Hagelkugel*) of ingenious construction and

(*) See the Criticism upon this work in England, at the end of the volume.

very powerful effect, in which my metallic *time fuze, (la fusée métallique Belge)* in all its essentials, was successfully applied.

The English newspapers and other publications have often spoken of the Armstrong guns; but rarely mention, in connexion with them, the projectiles belonging to these guns, and when they do so, the importance of the projectiles to the whole system has never had due consideration. The gun was generally put forward so prominently as to exclude from view projectiles and fuzes; as if the value of the system depended on the gun alone. This is a great error; for whatever be the system of ordnance pieces, with smooth or rifled bore, the projectile has always a more extended influence on the efficiency of the fire than the piece which throws it. It is to the perfecting of exploding projectiles and fuzes, that we owe the greater part of the destructive power by which Artillery has gained its present eminent position, and whereby in future it may exercise a still mightier influence on military and naval operations. It is no longer disputed—

That an Artillery, armed with pieces and fitted with explosive projectiles both of the best construction, will be able to develope *the greatest destructive force* attainable by such means, that is to say to acquire their most brilliant and most useful quality; —

That well constructed projectiles of this kind enable them to obtain tolerable and in some instances very great effects, even with pieces of much inferior quality (such as guns damaged by frequent firing);—

But that, on the contrary, the best guns (pieces) in the world (*) will never enable the most experienced Artillerists to obtain equal effects with the best constructed projectiles, if these are furnished with *irregularly acting* or *bad fuzes*.

The newest and most authentic intelligence

(*) The Armstrong guns declared by the late Lord Herbert to be such in the House of Lords, February 14, 1861 : "*Vote of thanks to the forces in China.*"

respecting the projectiles belonging to the Armstrong system, appears to be contained in a letter of Sir W. Armstrong himself, dated November 25, 1861, and published in the *Times,* November 27.

This letter throws a new light on the interesting question of the Armstrong guns, and rectifies several great errors lately circulated by the daily press, and tending to undermine the confidence, grounded on the *official reports,* which England and the military world attached to this new weapon. But that part of the letter which relates to the projectiles needs a rectification, which I feel it incumbent upon me to make in this place, having failed to obtain its insertion at the time in that journal.

Sir W. Armstrong in this letter, adressed to the Editor of the *Times,* says :

" I do not know whether your readers are aware " that I had to introduce with the gun an entirely " new system of fuzes and projectiles :—

" 1. A time fuze, which burns during flight, and

" which can be set so as to explode the shell at any
" given number of yards, or, as case shot, at the
" gun's mouth.

" 2. A percussion fuze, which is incapable in its
" original state of exploding the shell, though
" dropped from a great height, but which acquires
" by the act of firing so delicate a sensibility that
" it explodes the shell thenceforward at the ligh-
" test touch.

" 3. The sea-service percussion fuze, which, like
" the last-mentioned, has no sensibility before it is
" fired, never has sufficient sensibility to explode
" the shell by impact on the water or by ricochet,
" but takes effect on a ship's side, whether it strike
" it point foremost or otherwise, and bursts the
" shell in the very act of passing through the tim-
" ber.

" 4. The solid shot for battering, the common
" shell for explosive effect, and the segment shell
" for use against troops or the crews of ships,—
" three projectiles, the destructive power of two
" of which is on a scale hitherto unknown.

" Each of my field-service projectiles contains " the first and second of these fuzes. A slight " adjustment only is required, at the very moment " of loading, to determine whether it shall act as " solid shot, shrapnel shell, case-shot, or percus- " sion shell. Each battery of field artillery under " this system goes into action not merely with a " gun of less weight than formerly, and using half " the weight of powder, but, what is more impor- " tant, carrying many kinds of shot in one".—

From this conclusion it is evident that in N° 4, there is no reference to a real solid shot nor common shell, but that these projectiles are represented by the *Segment Shell*, that is to say by the Armstrong Shrapnel Shell, in which the leaden musket balls of the original English spherical case-shot are replaced by an ingenious combination of segments of strong iron disks, as shown in fig. 19 and 20 of General Sir H. Douglas' "*Naval Gunnery*," 5th Edition, London 1860.

The Armstrong projectile having no windage in the bore of the gun, the flame of the charge of the

piece is not employed to set fire to the fuze N° 1.; but a concussion apparatus (*), placed in the interior of the metallic body of this fuze, and acted upon by the shock which the projectile receives in the bore at the moment of firing the gun, serves this purpose (fig. 21 and 22 in the "*Naval Gunnery*" just quoted).

The field service projectile is to be provided with two fuzes; it appears that the bursting charge of the shell is placed first in the cylindrical space running through it in the direction of its axis; the percussion fuze (fig. 23 "*Naval Gunnery*") is next inserted and finally the space is closed by the time fuze screwed upon it and forming the apex of the projectile.

Fuzes may be divided into two categories : one represented by the *time fuze;* the other either by the *concussion* or by the *percussion fuze.* The

(*) Sir W. Armstrong applies to this apparatus the epithets *concussion* and *percussion* indifferently; but properly speaking the former is the correct expression, and his two fuzes indicated under N° 2 and 3, are in fact *concussion fuzes.*

second category can only be employed in a comparatively small number of cases in warlike operations on land and on the sea, while the time fuze is *indispensable* in the great majority of these cases; hence a time fuze, constructed on rational principles, affords the only sure *basis* of a system of explosive projectiles, whether calculated for smooth bored or rifled pieces,—and it is for this reason that the time fuze of the Armstrong projectile is of far greater importance than the two concussion fuzes used with it.

In the above cited passage, as well as in other published letters and speeches, Sir W. Armstrong puts himself forward as the inventor of the Time fuze indicated under N° 1. In a small pamphlet, however, which circumstances lately determined me to publish in German, viz : *The Prussian system of rifled ordnance field pieces in Belgium and the Time fuze of the Armstrong Shrapnel Shell* (*),

(*) "Das preussische System der gezogenen Feldgeschütze in Belgien und der Zeitzünder der Armstrong'schen Granatkartätsche." By Major-General Bormann. Darmstadt and Leipzig, 1861. With a chromo-lithographic Plate. (Reprinted from the *Algemeine Militär Zei-*

to which I beg to refer, it is incontestably proved, that this fuze in its most essential parts,—i. e. in those which constitute the time fuze properly speaking,—is the Belgian metallic fuze (la fusée métallique) adopted on my proposition, by the Royal Belgian Artillery since 1835.

Sir W. Armstrong, indeed, modified the metallic body or case of this fuze to a certain point in order to adapt it to his Segment shell (*). In doing this, however, he committed a *plagiarism* to my detriment, by taking out a patent in 1858 in which he appropriated my fundamental and original ideas in the Belgian fuze, and in its metallic body, as if they were his own, thus not merely availing him-

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tung of 1861, N° 27-34).—See also the two Criticisms on this pamphlet: 1., A. M. Z. of 1861 N° 46., Literaturblatt; and 2., the Berlin *Militair Literatur-Zeitung* of 1861, N° 8; — and finally a supplement to this pamphlet, inserted in the A. M. Z. of 1862, N° 15 and 16 (N° 19 Errata), under the head of "Die Geschosse der Armstrong'schen Kanonen" (*The projectiles of the Armstrong guns*). By Major-General Bormann.

(*) The chromo-lithographic Plate of the precited German pamphlet, shows, in fig^s. 3-7, the modifications which the metallic body of the Belgian fuze has undergone successively in different countries, from the original shape I gave it in 1835 to that which Sir W. Armstrong adopted for it in 1858 and 1860.

self of my ideas, but robbing me of the credit of the invention (*).

The British Government, on the other hand, in 1858 or 1859, made the acquisition of the said Armstrong patent, and the Royal Artillery adopted—and still makes use of—the Armstrong modification of the Belgian metallic fuze under the denomination of "*The Armstrong time and con-*

(*) In the London *Mechanics' Magazine* for October 23 and 30, 1858, Article : "*Armstrong's patent time and percussion fuzes for ordnance*" it is said :

" Mr. Robert Armstrong (correctly described in the following num-
" ber of the Magazine as Mr. W. G. Armstrong) C. E. of Newcastle-
" upon-Tyne, who has already done much toward the improvement of
" ordnance, has just completed a patent for a time fuze, in which the
" fuze composition is lodged in an annular groove, the continuity being
" broken by a stop, on one side of which the fuze has its commence-
" ment and on the other its termination. The duration of the burning
" of the fuze is regulated by causing it to be ignited either at its com-
" mencement or at some intermediate point between its commencement
" and termination".—This passage contains the alleged plagiarism; the lines that follow detail the modification which Sir W. Armstrong has really made,—

" This is effected by means of a revolving cover furnished with a
" tightening screw to fit it at any particular point, and containing a
" passage through which a jet of flame is directed upon the place where
" the burning of the fuze composition is intended to commence. This
" jet of flame is produced by the flash of a detonating composition
" which is contained in the body of the fuze, and is fired by the pene-
" tration of a point actuated by the force exerted on the projectile at
" the instant of firing the gun."

cussion fuze" (*), so that in England official acts and deeds attribute my invention to Sir W. Armstrong and sanction his plagiarism.

Against these proceedings I protested in vain in two Memoirs respectfully submitted, in 1859 and 1860, to Her Britannic Majesty's Government, and asking protection for other parts relative to the Hail-shell system (**), and equally exposed to be illicitly patented. H. E. the Secretary of State for War, the late Lord Herbert through his Secretary the late Sir Benjamin Hawes, rejected my claims on the *insufficient grounds* which the Woolwich Ordnance Select Committee, commissioned to examine my first Memoir, had adduced in their official *Report* N° 837, Mai 31, 1860 (***).

(*) The explosion of the bursting charge of the projectile being, as we have seen, determined by the ignited fuze composition, and not by the fire directly coming from the concussion apparatus, this denomination may lead to a mistake as to the true nature of the fuze; this fuze evidently is only a *time fuze* and does not unite the two qualities of a time and a concussion fuze.

(**) *Report* of the British Ordnance Select Committee dated "Director General's Office Woolwich 30 October 1852" and addressed to the late Lt.-General The Right Honourable Lord Raglan, G. C. B., &., &., then Master General of Ordnance.

(***) For farther remark on this Report see at the end of the volume: *The O. S. Committee.*

Considering that the British Ordnance Department received in 1852 from the Royal Belgian Government an *official communication*, conveyed by myself, of the invention of the Belgian metallic fuze together with the above mentioned Hail-shell system, I hope that I, as a foreign officer acting with perfect disinterestedness and serving herein as intermediary in an act of courtesy between my Government and that of Her Britannic Majesty, shall find in the verdict of the enlightened English public the justice which the British Military Authorities still refuse me.

The establishment of my right at this moment is the more indispensable, as the invention of the new principle of the time fuze has enabled the Royal Belgian Artillery to effect a real progress in one of the most important branches of the Artillery service, viz : *In the art of mastering the fire of explosive projectiles.* Under the above mentioned circumstances, however, it is very possible, that at the *International Exhibition* of London, 1862, this progress of the Royal Belgian Artillery may not have been duly distinguished from the progress

due to the Royal British Artillery by the practical application of the Armstrong system of guns and projectiles,—an error which no Englishman, devoted to his country, could wish to see perpetuated by farther public acts, for England is too rich in inventions of the highest utility to need to deprive any other country of the credit of an invention which is fairly its due.

In the last *International Exhibition*, Sir W. Armstrong has exhibited another model of a metallic time fuze, which also, however, is *essentially* the Belgian metallic fuze, differing only from the so called "time and concussion fuze" in some details of arrangement; viz. in as much as the concussion apparatus, destined to ignite the fuze composition, is modified and placed not in the axis and in the upper part of the metallic body, but in the main part of it, underneath the prism of composition, and by the side of the chamber (*d* fig. 6 and 7 coloured plate of my German pamphlet), filled with powder, the explosion of which determines that of the bursting charge of the projectile.

From § 8 it will be remembered that the Breithaupt modification of the body of the metallic fuze (*) was still wanting some improvements in order to render the service which is to be expected from it, viz: to simplify the operation of timing the fuze, and not only to *undo* the timing of the fuze when this has once been timed, but to modify the timing for a *longer* or a *shorter* range of the projectile as may be required, so as *to leave the normal state of the fuze unaffected by the operation of timing.*

The obstacle to realizing this valuable result lies

(*) It may be concluded from p. 38, that I have raised no objection against improvements of this kind, especially not when made by Artillery Officers; but I have felt it necessary to protest against the illicit traffic in the Belgian fuze carried on by parties in Hanover and in England at once depreciating and appropriating my original idea. The O. S. Committee of 1860, alluding in their Report N° 837 to the claims of the *inventor* as distinct from those of the first *realizer*, overlook the fact that I myself was one and the other, and ascribe to Sir W. Armstrong all the merit of the invention. Similar pretensions have been put forward respecting the Breithaupt pattern, but Captain v. Breithaupt — now Major in the Austrian Service, — claims to be excepted from this censure, referring for proof of this to the papers which he has submitted on this subject to his Government and to the German Confederation. Though these papers have not been published, I am happy to render to this Officer the justice he claims.

in the circumstance, that the channel containing the prism of composition is not *hermetically* closed by the *moveable regulating* (timing) *disk*, so that the fire from the given initial point may flash over the whole or part of the composition, and cause premature or irregular explosion of the projectile; —and that damp air, and occasionally water, may find access to the fuze, and thus impair it or destroy it entirely; an inconvenience to which the fuze is especially liable on board steam vessels (*), and in heavy rains.

These inconveniences, however, may be prevented :

1st by rendering the prism *airtight* as in the

(*) See at the end of § 14 (or *Shells and Shell guns*, p. 142.) Captain Dahlgren's judicious opinion on the speedy deterioration to which all kinds of laboratory stores are exposed on board steam vessels;— as well as the opinion which Major Alfred Mordecai, of the U. S. Ordnance Department, gives on the Breithaupt pattern in his "*Report*" entiled "Military Commission to Europe in 1855 and 1856. Washington 1860", printed by order of the Senate; Part X Shrapnel Shell, *Austria*, Plate 20 fgs. 2 — 4.—In the same work Part X, Plate 19, the reader will also find a description of the English Fuze-and Shrapnel-System invented by Captain (now Colonel) Boxer, R. A., with a judgment on it, which in its principal points coincides with that which the reader may himself form on that system from §§ 7—14. Major Mordecai, by his other works on Artillery, is already known in Europe as an experienced and enlightened Officer of Artillery.

original fuze, by means of a thin metallic plate, which, for the purpose of conveniently igniting the fuze composition, may be made of *an alloy* of which the point of fusion is sufficiently low; and

2d by employing, if the fuze is adapted to spherical shells, a *Protecting plate,* similar to the moveable regulating disk in the Breithaupt pattern, against the violent action of the inflamed gas created by the discharge of the piece; or, if adapted to the conical part of cylindrico-ogival shells, by using a *Protecting cone* against the damage the fuze might be exposed to, when the projectile is ricochetting on the ground.

This protecting plate and this protecting cone, however, differ essentially from the Breithaupt regulating disk, the cone especially, which, according to the purpose in view, may be fitted either in a fixed or in a moveable position, not touching the plate bearing the Time Scale and covering hermetically the prism of composition.

So improved, the Breithaupt pattern would

answer the conditions I laid down in § 8 and Note C (as in the first Edition) for the *beau idéal* of a Time fuze, which I proposed in Belgium.

It is true I included in these conditions the suppression of the movement of loosening and tightening the screw by which the protecting plate is to be pressed down on the prism of composition; but though it may be possible to substitute for this action, that of a strong spiral spring in fuzes calculated for spherical shells with windage in the piece, yet this contrivance may be found insufficient for fuzes fixed to cylindrico-ogival projectiles for rifled guns.

It is not to be forgotten that the application of the spiral spring must always complicate the mechanism; practice alone can show where its application is suitable.

In the English modification of the metallic fuze, Sir W. Armstrong went a step farther, and approached the *beau idéal* of the time fuze much nearer than Breithaupt.

He wrapped the prism of composition in varnished paper, applied a moveable regulating disk similar to the Breithaupt disk, apparently for the purpose of protecting the fuze, and made use of the tightening screw to press this plate down on the prism. The Armstrong Segment-shell having no windage in the bore of the gun, the fuze being placed in the apex of it, Sir W. Armstrong enclosed in the metallic body of the fuze, as will be remembered, his concussion apparatus for the purpose of setting fire to the composition at the moment the ignited charge of the piece acts upon the projectile in the bore.

Two motives may have led to the choice of this measure : the belief that the flame of the gun cannot serve the purpose above mentioned in forced projectiles; and next the intention to secure in a higher degree, than formerly, the ignition of the fuze by that flame in projectiles with a windage in the bore. Remembering, however, that one of the advantages of the new principle of the time fuze is, to allow the fuze to be adapted *to the exterior surface of the projectile in its whole*

length, it will be obvious that both of the purposes indicated may be realized by some other means, especially if the suppression of the concussion apparatus should be deemed desirable : for instance, by encrusting the fuze *in form of a Ring*, at the exterior surface in the bottom of the cylindrico-ogival shell, and in having the fuze sheltered by the protecting plate, and ignited by the heat which the exploding charge of the piece develops,—a proposal I made in Belgium for Shells and Shrapnels belonging to the Prussian System of rifled field guns (*).

In Germany several experiments are said to have been made to execute this plan, but without success. Being unacquainted with the manner in which this was done, I am unable to explain their failure.

The degree of perfection attained by the mechanical arts in our day, however, is so high that its successful execution is no more to be doubted, for

(*) See my German pamphlet 1861, pp. 21 and 27.

we may evidently demand, that the metallic fuze shall be so constructed that its solidity be such as:

1., to resist any shock to which the projectile is liable in the bore of the gun, or in recochetting on the ground;

2., to resist the flame of the piece; and

3., to be secured against all influence of moist air or water in the above mentioned manner, so that a projectile with its fuze *already timed*, might, before firing it, be immersed in water without detriment to the intended effect of the fire.

Finally the new principle of condensing the composition insures the regular action of the fuze on the bursting charge of the projectile, which constitutes the essential point in the question.

A time fuze having the qualities of the *beau idéal* will, of course, be also the most complicated and the most expensive one; but though such a fuze must be highly desirable for the service in field batteries, because it would unite in it the highest

possible completeness attainable for the purpose, with the greatest possible facility for the application of the fuze in action on the field of battle (*en rase campagne*),—yet the original fuze much simpler, much cheaper, timed by a cutting instrument, will prove its particular value in other cases occurring in war; for instance in the operations of attack and defence of fortresses, coasts, ships, etc., in many of which cases the application of the *beau idéal* of a time fuze would be rather a costly luxury, than an absolute necessity (§§ 7 and 8).

Sir W. Armstrong asserts, that he can set (regulate or time) the time fuze of his projectile so as to explode the latter "at any given number of yards" from the gun. This pretension is inadmissible on account of the incalculable resistance the projectile finds in the air, and on account of the different power with which charges of gun powder, though of equal weight, would act on the same projectile in the bore of the piece. The real advantage, however, which my metallic fuze insures to the Armstrong projectiles is : that the explosion of the shell may be determined at any point of its

trajectory, either close to the muzzle of the gun or after having travelled through the atmosphere during *a given lapse of time,* and this with an accuracy approaching to *mathematical exactness.*

This result, the achievement of which is a *sine qua non* for the Artillery of the present day, can never be attained with fuzes in which the composition is condensed as in the old column shaped fuze in use for three centuries past (*), its nature being opposed to it.

If we divide—as in the Belgian Artillery,—the trajectory of the shell in *nodes* numbered from the beginning of it to its end thus :

0, 1, 2, 3, 4, ... n

at which points the projectile arrives after the lapse of

0, 1, 2, 3, 4, ... n *half-seconds*,

the bursting of the shell may be determined, at

(*) Since 1566, at least, as stated in the already cited work of Colonel Favé, p. 264., in the following words : "On cherchait déjà la fusée des projectiles creux dont l'idée remonte ainsi en Allemagne au-delà de 1566".

pleasure, at any of these *nodes* or at any point in the spaces between them.

There is no doubt that ranges may be more easily and surely estimated by adopting, as the basis of calculation, *the time of flight* of the projectile rather than a *linear measure*, and considering that this basis is applicable to all charges for guns, and to projectiles of every kind and calibre, it must be admitted, that a scale for the metallic fuze founded on the time of flight (as in Belgium the "*échelle de temps*") is much preferable to one, founded on given ranges in yards, mètres, etc.,— The scale of times in the Belgian fuze, corresponding with the above cited series of ranges expressed in *half-seconds*, has subdivisions for the time of burning into $\frac{1}{4}$ and $\frac{1}{8}$; and, by estimation, $\frac{1}{16}$ of seconds may be given.

Sir W. Armstrong ascribes to his projectile when used for explosive effect, and when used against troops or the crews of ships, a destructive power on a scale "hitherto unknown"; to his projectile he also ascribes the grand quality of being fit to be

used for different purposes, viz, "as solid shot, Shrapnel shell, case-shot or percussion shell", and represents all these dispositions as if they never had existed before;—by my statements and by the description of the Hail-shell system in § 18, however, the reader will be convinced :

1., that the Royal Belgian Artillery had already realized advantages of the same kind and some more important ones, with spherical projectiles, but, of course, within the ranges attainable by smooth bored cannons, howitzers and mortars, and with the exception of the effect of percussion shells;

2., that these improvements in the Artillery Service originated in Belgium and that even the Royal British Artillery have had them at their disposal since 1852, or before the introduction of the Armstrong guns.

The Belgian incendiary hail-shell (*le Shrapnel incendiaire*) (*) adopted since 1836, for instance

(*) It may remembered, by the way, that the incendiary cylinders

may be used ad libitum as solid shot, as common shell, as Shrapnel shell, as incendiary shell and as case-shot; the same may be said of the simple hail-shell, wanting only the incendiary power.

On the proposition of the superior Ordnance commission (la commission supérieure d'Artillerie) at Brussels, the 20th field battery of 8 long brass howitzers of 15 centimètres (24℔) also carried as early as 1838 (in time of war) many kinds of shot in one, viz. in the Hail-shell, to which projectile were added some common shot to serve in cases of utmost need. Each of these howitzers was provided with :

	In the limber.	In the ammunition wagon.
A. *Obus à balles* (simple hail-shells)	22	38
B. *Obus à balles incendiaires* (incendiary hail-shells)	4	8
C. *Boîtes à balles* (common case-shot)	6	6
In all, shot...	32	and 52, with

D. Two kinds of charges : one of one kilogramme, the other of half a kilogr. of powder.

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of this projectile are not to be confounded with the incendiary cylinders in the French *Naval Shell* mentioned by Sir H. Douglas, Naval Gunnery, 1860, p. 308. The latter cylinders appear to be bits of a sort of *roche à feu* in a cylindrical shape, furnishing much intenser heat than the common *roche à feu*, but being, on account of their absolute and specific weight, deprived of the momentum which those of the incendiary hail-shell retain, after having been set at liberty by the explosion of this projectile in its flight.

From the foregoing explanations it may be concluded, that the English *Segment shell* is, by virtue of its construction, a very powerful Shrapnel projectile, but that the Belgian *incendiary Hail-Shell* of the same calibre and length, applied under the same conditions (*conditions du tir*), cannot be inferior to it. This hail-shell, moreover, being also convertible into a percussion projectile, evidently will prove, when so used, to be equal to the Segment shell, and even superior to it when applied as common shell for explosive, or as solid shot for battering effects,—while the Segment shell is entirely destitute of incendiary power.

If the Armstrong *Sea service-percussion fuze* renders the service indicated under N° 3, it will be highly prized by artillerists, because it supplies a want hitherto felt by the Naval Artillery and the coast batteries (*).

(*) A new pattern of a *concussion fuze*, founded on another principle than that in the above mentioned fuze, but destined for the same purpose, has been constructed by Sir W. Armstrong, A full description of it with illustrative diagrams is given by Sir William himself in the work: "Excerpt minutes of proceedings of the Institution of Civil

The Armstrong system comprises also *incendiary projectiles* of a particular nature. It will be wonderful, indeed, if the Armstrong guns prove capable of throwing incendiary shells of the description which Sir W. Armstrong indicates in his letter of November 25, 1861, when contradicting Captain Halstead, Royal Navy, in the following words :

" He (Captain Halstead) says the gun cannot " throw an incendiary (Martin's) shell. Here he " is utterly wrong, for even the lead covered shell, " to say nothing of the ribbed one, has been suc- " cessfully fired with molten iron in both 40-poun- " ders and 100-pounders".

Not knowing sufficiently the construction of these missiles, I abstain from comparing their efficacy with that of the incendiary shell and bomb

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Engineers". Vol. XIX, Session 1859-60, published in London 1861, translated into German by Captain v. Hartmann, Royal Hanoverian Artillery, and inserted in the Prussian Archives for the officers of their Artillery, etc. (Archiv für die Offiziere der K. Preuss. Artillerie, etc. Band 51, Heft 2^{d}, Berlin 1862, Section VIII. Taf. II, fig. 1 and 2.)

of the Hail-shell system, which, however, is of a quite different nature, so that the one could never be completely substituted for the other.

With the introduction of the rifled guns the Shrapnel question entered into a new stage, the characteristic feature of which is the use of *concussion fuzes* of so sensitive a nature, that they determine the explosion of the projectile, not only on the first grazing of the latter on the ground, but at the slightest resistance it finds in touching an object in its flight.

The English employed, as we have seen, the concussion fuze indicated in Sir W. Armstrong's letter under N° 2, simultaneously with the time fuze N° 1. Is this measure regularly adopted, or was it only occasionally adopted in the Chinese war as a temporary precaution in case that the time fuze should have failed to act as intended?—I cannot tell. Supposing the latter fuze well fabricated as may be expected from the progress of the mechanical arts in our day, the application of the concussion fuze ought to be reserved for the cases

in which the action of the time fuze could not be substituted for that of the concussion fuze. This, however, will seldom happen, unless the Shrapnel projectile be fired instead of a common shell for explosive effect, and then this use of it would only be justifiable in some particular cases.

The Prussian Artillery, on the contrary, and the Artillery in several other countries of the European continent, in which the Prussian System of rifled field pieces is adopted, fire their Shrapnels as well as their shells, with the concussion fuze, which is called in Germany, though improperly, "*The Prussian percussion fuze*" and which is not less sensitive than the Armstrong fuze N° 2; but, strange to say, this fuze has formed until now the *basis* (*) of the Prussian Shell and Shrapnel fire.

(*) I say *until now*, for the latest news from Prussia indicate, that their Artillerists are occupied in applying *a time fuze*, and which is virtually *my fuze* or *the Belgian metallic fuze*, to their Shrapnels and Shells for rifled field guns, a measure which may well have been expected from an Artillery abounding in Officers of the highest intelligence and skill. (See *Archiv für die Offiziere der K. Preuss. Artillerie*, etc. Band 52, Heft 1, p. 15, Berlin 1862).

Solid projectiles are not in use with these rifled guns.

Theory and practice evidently point to the use of the *time fuze* for the fire of the Shrapnel projectile, not only in order to produce the *maximum* of effect attainable with it, but also in order to *render Artillery entirely independent of the configuration and quality of the ground (terrain) occupied by the enemy;* one of the most important acquirements of modern Artillery, and solely due to the rational combination of Shrapnels and shells with the new or improved time fuze.

It is not to be doubted, that a great moral and physical effect may be produced by a concussion Shrapnel, if it fall into a column of troops or into a square. The effect will be equally decisive, if the enemy be standing on a plain hard soil, such as most of the Artillery practice grounds offer, and if the projectile, after having struck the ground at the required distance before the enemy's line, bursts in the *ascending branch* of its continued trajectory and from 5 to 8 feet from the point

of impact and 2 or 3 feet over ground, as the Prussian Shrapnels do;—but this can only be the case at the nearer ranges, for, it is evident, that the farther off the first grazing of the projectile takes place, the more precarious must be the result, so that at the farthest ranges of rifled guns a very weak effect only can be expected, or perhaps none at all.

At the nearer distances this fire has something attractive; it pleases every body, the professional man as well as the unprofessional spectator, and valuable, brilliant effects, indeed, have been obtained with it on targets. Another attractive point in it is, the greater apparent facility and certainty with which ranges may be measured and estimated, and the fire regulated by the Shrapnel which bursts at its first touch of the ground, than by one the explosion of which is determined by a time fuze in the air and in the *descending branch* of its trajectory; both these appearances, however, prove deceptive wherever the ground is uneven and intersected by hedges, enclosures, ditches, trees, rivers, swamps, mountains, etc.; — wherever the enemy's troops are posted behind breast-works,

between traverses, in trenches or on a sea coast, and on board ships. Even if standing in a field of full grown wheat or one covered with high coarse grass, as in the North American Prairies, the resistance would be sufficient to cause premature explosions of the Shrapnel i. e. explosion before striking the ground at the required point.

The principal objection to which this theory of firing Shrapnels is liable is, that the *sheaf* (*gerbe*) formed of the fragments of the projectile, takes an *ascending direction,* which must lead frequently to dispersion whereby the effect is reduced to nothing, so that in many cases in which Shrapnel fire would be desirable, its practice must be dispensed with. Finally this inherent deficiency of the fire excludes the use of Shrapnels first from Mortars, i. e. the fire of hail-bombs, and next from rifled guns with weak charges at high angles of elevation, which, in case of need, may be substituted for the powerful Shrapnel fire from smooth bored howitzers.

The influence of all these weakening elements

may be considered as an immense *loss of destructive power.*

To this disadvantage the theory founded on the time fuze, is not subject, as it allows in all cases the development of the *maximum* of destructive force attainable with Shrapnel fire; for it is obvious that it is always easier for the enemy to protect himself against direct than against vertical fire.

It is the same with Shell fire in an open field of battle; but it is *otherwise* in some particular cases, in which this fire may be rendered excessively destructive by means of a concussion or a percussion fuze; viz. in battering in breach or in demolishing embrasures, detached revetements, blockhouses, caponieres, casemated redoubts, etc.

The most rational and economical plan, therefore, appears to be that which the Royal English Artillery has adopted for Shrapnels and extended to Shells; viz. to carry into the field Shrapnels and Shells so constructed, that they may be *permanently* fitted with a metallic time fuze, on the

new principle; and *temporarily*, as required, with a concussion or with a percussion fuze; a plan which may be executed in a thousand different ways, so that *any System of rifled ordnance* may be improved by the application of this time fuze, just as *the English System of rifled guns* has been improved by the adoption of it. It is, of course, to be remembered that such a rule would have its exceptions, as for instance in permanent positions, in which, as already stated, the original simpler and cheaper pattern of the Belgian metallic fuze may be advantageously applied as well as concussion or percussion fuzes.

After the foregoing statements respecting rifled guns, it will be obvious to the reader that additional progress has been made in the Shrapnel fire grounded on the time fuze new principle, owing to the fact that the operation of timing may be reduced, in field batteries, to the simple movement of turning a protecting plate or cone; and that projectiles with fuzes already timed, may be otherwise disposed of. As to the use of the metallic time fuze in general, it will be remembered, that the Officer

commanding the fire, has only to take into consideration the distance of the enemy in order to be sure of the efficiency of his fire,— while, on the other hand, when using concussion Shrapnels, he requires to have, besides this, an exact notion of the configuration and nature of the ground which the enemy occupies.

The knowledge of the distance, in itself a difficulty not easily overcome, therefore, will be the next important problem for Artillerists. Space is wanting here to enter upon this interesting point of Artillery practice.

Sir W. Armstrong, it must be acknowledged, appears to have perfectly understood the importance of the Shell and Shrapnel question, in grounding the fire of his Segment Shell on my metallic time fuze and adding occasionally to this shell a sensitive concussion fuze for field service, and a less sensitive one for service on board ships or in coast batteries. He, moreover, appears to have been the first who adapted that metallic time fuze to *forced* projectiles for rifled guns (breachloaders),

and who at the same time applied a new method of igniting the fuze in substituting the action of a concussion apparatus for that of the flame of the gun, hitherto used for that purpose (*). But the Royal British Artillery, as it was the first to employ *improved Hagelkugel fire* in General Shrapnel's spherical case-shot from smooth bored guns during the Peninsular war, 1808, so has it a second time the credit of a successful initiative in having applied improved fire of this kind, in the Armstrong Segment Shell from rifled guns on the open field in the last Chinese war, 1860;—an *Initiative* of no less value and importance, than that, which this arm owes to the Imperial French Artillery for the first successful application of *rifled field guns in war,* in the Campaign of Upper Italy in 1859.

(*) As to the application of my metallic time fuze to *shells* for rifled guns in France and in Italy, see my German pamphlet, 1861, note to p. 19 fig 8 of the Plate. It appears that General Cavalli, Royal Italian Artillery, —who first brought into use the rifled guns in modern time,—has combined in an ingenious manner and in the same metallic body, a *percussinn fuze* with the *time fuze* fig. 8, so that the shell may be used with one or the other and that it will not explode on touching the gruund, but only on striking, point foremost, directly against an object of considerable resistance.

Additions to pages 169 and 179.

1. *The British Ordnance Select Committee.*

It is known that this Committee is composed of a considerable number of Officers of high rank, selected from among the most scientific, experienced and enlightened Officers of the Royal Artillery, and is justly renowned as one of the ablest and most important Committees of the kind existing.

In 1852 this Committee, formed of nine highly distinguished Officers, consummate artillerists, rejected the Belgian metallic fuze. Although it cannot be supposed that they should not have been able to appreciate its real value as clearly as six years later the Civil Engineer Mr. W. Armstrong did, and to appreciate the value of the Hail-Shell System as a whole; or that incapacity was the real cause of failure in the fabrication of the fuze in 1853 and 1854 in the Woolwich Arsenal (Report N° 837);—this rejection may be explained; for in all countries instances occur in which irrelevant reasons have determined the rejection of Systems, and, after all, the Government was free to *choose any fuze or any projectile they pleased.* It is not so easy to find a satisfactory explanation of the reasons assigned in the Report N° 837.

It may be fairly supposed that this Report does not express the individual sentiment of every member of the Committee, but only of the five members commissioned to consider and report upon the case in question. In support of this supposition it will be sufficient at present to cite the following passages from it.

In part 6 of Report N° 837 the Committee state :

" It is fully admitted by Sir W. Armstrong that before devising his " Time fuze he was aware that the method of applying the fuze com- " position in a circular and horizontal form had been adopted on the " Continent and that he has always regarded Major-General Bormann " as the originator of that system".

In part 7, however, they

" Think it equally due to Sir W. Armstrong to point out that the

" feature thus borrowed from the Belgian system, is far from amount-
" ing to an adoption of the "*Belgian Metallic Fuze*".—Here the Committee confound the two different significations of the word "*Fuze*"; viz. 1st, the fuze properly so called, i. e. in the present case the prism of composition; and 2d, fuze, the metallic body of the fuze charged and prepared for use.

In part 7 the Committee pretend that my "improvement in the fuze, " the value of which they readily admit, is but an accessory".—Speaking of the old column shaped fuze (§ 5) it might be supposed that they consider Sir W. Armstrong's modification of the metallic body of my fuze as the principal improvement of the Time-fuze in general.

In part 8 the Committee assert :

" There is no resemblance of detail between Sir W. Armstrong's " Time fuze and the Bormann fuze, except that both have the compo-
" sition in a horizontal ring; the interior arrangements and the mode " of adjustment are entirely different"—and farther down in referring to a Diagram which I have reproduced in figs 3 and 7 of the Plate annexed to my German pamphlet of 1861, already cited :

" The construction of the Armstrong time fuze has been made public " and the Committee enclose for Mr. Herbert's satisfaction a diagram " exhibiting a section of this fuze and also of the Bormann fuze; by " which it will be seen on what slender ground the former is said to " be a copy from the latter."—

Thus the essential parts of the fuze are again declared to be secondary parts and vice versa, and satisfaction is given to the Minister of War by a diagram which proves just the contrary of what the Committee intended to prove.

And finally the Committee state in part 8 :

" The Bormann fuze requiring a fuze hole of about 1.55 inch in " diameter could not in its present form have been applied to the apex " of the smaller Armstrong projectiles; even if its construction pre-
" sented the advantages of the Armstrong Time Fuze which it does " not", etc.—A statement which can only be understood by knowing that the Committee refer here to the Belgian pattern of my fuze cal-

culated for spherical shells to be fired from smooth bored guns in the bore of which the projectile has a windage.

In all Continental States a Committee like the Woolwich Ordnance Select Committee, is subordinate to and their acts are controlled by the Ministry of War, for which latter purpose several experienced Officers of Artillery are attached to this Ministry. If it may be supposed that a similar control is exercised in England, it may be presumed that the advice of these professional Officers on Report N° 837, if ever asked, had not been followed.

From the first of the above cited passages from this Report, it will appear, that the question before the British Department of war, was no longer a *technical question*, but one of honour and equity.

2. *Criticism on my historico-technical Sketch, first Edition*, 1859.

To the above Official judgment I beg to oppose one on the same subject, published in a daily paper, in the London *Morning Post*, August 27, 1859. Article "Major General Bormann on Shrapnel Shells", which gives a brief and impartial account of the work. The Editor of this influential paper says :

" Concerning the variety of Shrapnel fusee there are almost as many " as there are services in which Shrapnels are employed. Many com- " petent judges there are who believe the variety of fusee devised by " Major General Bormann to be the very best employed in any ser- " vice ; but however much critics may happen to differ as to this, they " will, one and all, be ready to allow that Bormann's fusee is in the " highest degree ingenious; that the talented Belgian has worked " more at Shrapnel shells and their fusees than perhaps any man " living, and, consequently, that anything he has to say on the matter " is worthy of all attention. Major General Bormann has a still fur- " ther claim to the notice of Englishmen just now. The Belgian " Shrapnel fusee is confessedly the model, or rather one of the models, " upon which the fusee of Armstrong's shell is constructed. The " timing arrangement of Armstrong's fusee may, in point of fact, be " designated as Bormann's contrivance in every essential particular".

A similar testimony is borne by the author of a valuable treatise entitled "*New resources of warfare*" By J. Scoffern. London 1859, page 40.

Besides the account of my work in the *Morning Post*, three others published in England have come under my notice; viz. one in *The Mining Journal*, June 1859, the second in *The Artisan*, August 1859; both impartially written and with a view to the instruction of their readers. The third, inserted in a military monthly publication, *Colburn's United Service Journal* for September 1859, signed S. W. F., is of a very different character; but this virtually anonymous article is deserving little consideration, as it assigns no reasons for the absurd assertions it contains. Moreover, it is written in a style of low banter utterly unbefitting a military journal and does the greatest wrong to two honourable Officers, Colonel Delobel, Royal Belgian Artillery, and Captain Toll, Royal Prussian Artillery, as well as to myself. It professes to doubt the authenticity of the Old German Manuscript of the sixteenth century (1573) deposited in the Library of the Grand-Ducal University of Heidelberg, and mentioned in § 15 and in Appendix III. The authenticity of the MSS., however, is placed beyond dispute by an *Official Document*, N° 370, dated Heidelberg, November 12, 1859 and signed by three distinguished Professors of that University: Professor D^r^ Sachsse, D^r^ C. Thibaut and D^r^ G. Weil.

It is to be hoped that this Document will be published in the Annals of the University in vindication of the German Artillerists.

Brussels. — Printed by L. TRUYTS, rue Keijenveld, 91, faubourg de Namur.