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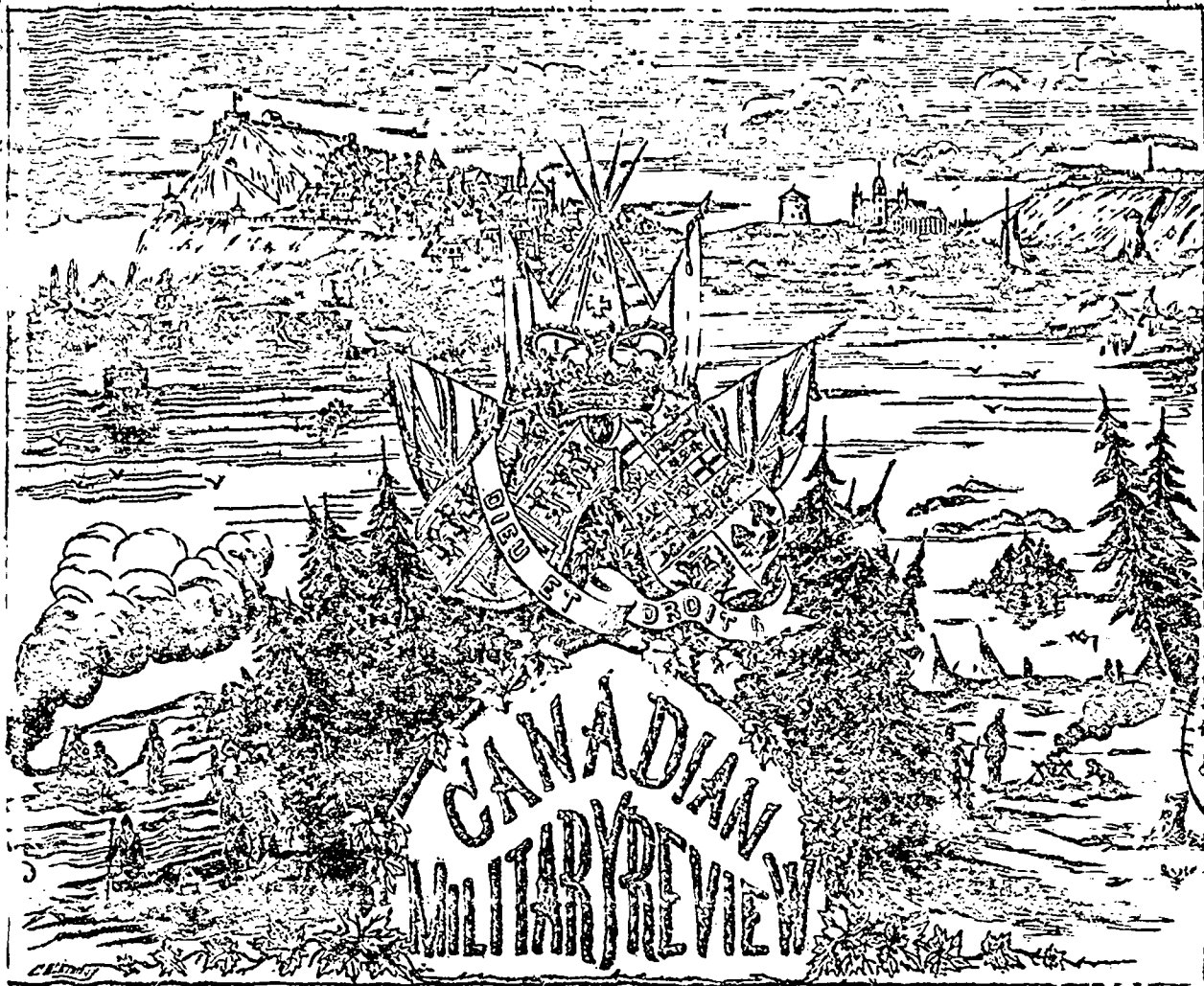
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NOTICES..

All correspondence connected with the *C. M. Review* should be addressed to the Secretary, R.S.G., Kingston.
Communications intended for publication in the next issue of the *C. M. Review*, must reach the Editor not later than the 25th of the month.

NOTE.—Officers of the Militia are requested to kindly forward to the Editor, for insertion in the "Militia Item" column, any information respecting their own regiments which they think might be of interest to their brother officers.

List of useful scientific books for sale, published at the Royal School of Gunners, Kingston, Ont.:-

Canadian Militia Field Artillery Manual, (by Lt-Col T. Bland Strange).....	75
Retrospect of the late Franco-German War (same author).....	70
Pr. Field Gun Drill, (extract from C.F.A.M.).....	10
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AVIS.

Conformément à la loi, toute personne qui reçoit un journal et qui ne le renvoie pas, se trouve abonnée de droit.

Les personnes qui auraient quelques communications à nous adresser sont priées de nous les envoyer avant le 20 de chaque mois.

Les personnes qui désirent entrer dans la Batterie "B" sont priées de se présenter au Commandant, (Kingston), tous les jours de 10 heures à midi, ou de lui envoyer leur demande avec leurs certificats de bonne conduite. Il faut aussi qu'elles sachent lire et écrire qu'elles jouissent d'une bonne santé, que leur hauteur ne soit pas moindre de 5 pieds 4 pouces, la mesure de la poitrine de 34 pouces. Enfin, nous les prévenons que les ouvriers charpentiers, menuisiers et forgerons ont une extra-paié de 20 cents par jour.

La Batterie "B" informe le public militaire qu'elle tient à sa disposition les ouvrages de drill pour le smooth bore, le modèle, les canons rayés etc., ouvrages imprimés par les presses de l'École Royale d'Artillerie sous la haute surveillance du commandant.

From East to West.

(From a Military Correspondent in Afghanistan.)

MY DEAR OLD FRIEND,—I can only re-echo your wish that you were here now, though I do not doubt for a moment that you would be breaking your heart, as I am, at the chaos of affairs in this country. Friends write and ask me to say what will be the result of it all, to tell them what is the best solution of the Afghan question? Every one has now become an upholder of the Lawrencian policy. But it is too late. Most of us of that school who raised up our voices and used our pens against any advance into the country see no other solution of the Afghan question than a total annexation of this huge frontier province or quadrilateral. The anarchy and confusion is hopeless, and I say that just as the murder of Cavagnari was laid at the door of Lord Lytton, so I now honestly declare that a total withdrawal of our forces from either northern or southern Afghanistan will be a national crime to be laid at the door of that Government which orders it. No one appreciates more than I do the immense burden which would be thrown on the Indian revenues by annexation, a burden such as India alone would find it difficult to bear; no one would more candidly admit than I do—and I laid great stress on this fact four years ago, when trying in a humble way to show the folly of a war—that the country can never support the expense of an army necessary to hold it in peace and safety, but at the same time I see no prospect of any one man being able to hold the reins of Government without the aid of British bayonets. If we leave the country, we leave every one who has given us the slightest assistance during our occupation, to murder and rapine, and in my opinion the British flag, the British honor of which we are all so justly proud, will be fouled with a stain so deep and black as to be indelible. I write strongly as I feel strongly. Only the other day the Logar Valley was occupied by a brigade or division of the Kabul army. Our troops were rationed and assisted by the Sirdar of the district. Hardly were our forces withdrawn than the Sirdar and all his followers were foully murdered, and public too, for having been friendly to us. And this same fate awaits hundreds and thousands. To me it is a wonder that they help us in any way after the public proclamation of our withdrawal. I firmly believe that all the people and a great number of the Sirdars would welcome us as conquerors and occupiers of their country. To come to minor political points, we have raised up, by our own ill-digested policy, a host of aspirants to the throne, and have allowed numbers of quite unknown and formerly impotent chiefs to taste the fascinating sweets of independence. For months past these have been roaming the country and carrying sword and fire at their wicked will. Will they quietly accept a Lew Ameer, whoever he may be? Whereas three years ago there were only three aspirants to the "Guddee," viz: Yahob Khan, Abdoola Jan and Abdul Rahman, now there are at least ten. Of these I believe the former to be the strongest; but, of course, after his murderous treachery he cannot be allowed to return. Abdul Rahman, I infer, has been too long away from Afghanistan to have any real hold on the people. Abdoola Jan would probably have a strong following, but no general or powerful influence. As for the others we need not name them. The hatred of the English in Afghanistan, fanned as it by fanaticism of the Mullahs, has become so intense now that it has become known that we are about to withdraw from the country, that we may say the part of the Afghans the strife is a religious war, to drive us beyond the frontier. Our forced inaction all tends to increase and encourage this feeling, and to me there seems to be but one solution—Annexation. We may have to beat and break up each of these chiefs in succession, but there will be a large proportion of the Afghans—those who have helped us already and those who would have but for fear of after consequences, who will join our standard at once. For years our difficulties would be great, perhaps even the next generation might not see the taming of some of the tribes, but we should have saved thousands from a needless death, and keep our national honor unstained. If I could only hope that we could find a strong man who would give us some tangible security for the well-being and safety of those friends we left behind us, then I say let us clear out of the country south as well as north as fast as possible. But I cannot bring myself to realize an Afghan monarch true, staunch and powerful enough to be capable of carrying out a humane policy. For enlightenment we cannot look. Mercy is not a component part of Pathan nature. Annexation, with all its evils, with all its burdens is the only solution possible of the Afghan question, as it now stands in July, 1880. There, old friend, I have let my thoughts run away with my pen. When you are reading this by your fire-side in Canada, you may have telegrams in your hands prying how utterly wrong I am in all I have written. I would ask you to wait. Our difficulties began in 1841, when the Governor of India ordered a partial withdrawal of the troops. Let us see what will

of the Afghans won't accept. But there, I have bored you enough with my evil prognostications and become verbose into the bargain. The numbers of your new military journals reached me all safely and actually—such are the vagaries of our postal service—before your letter. I think the attempt capital, and you must certainly place my name on your list as a subscriber. I am so glad to see Canada attracting attention in more ways than one. Put me down as one of your Manitoban colonists. I shall never set foot in England, and should like to hang up my sword with yours.

Afghanistan, 11th July, 1880.

Echoes from the Military Clubs.

(From a London correspondent.)

We are all distressed at the sad news arrived to-day from India, Colonel St. John, Royal Engineers, who sends the telegram from Candahar is an old friend of mine. His knowledge of the country and language led to his appointment as political adviser to General Burrows. It now appears that the General did not arrive at Candahar among the first, but a doctor of the same name. The General has come into Candahar with the remainder of his Brigade. I know the Afghans, and therefore can safely say that no wounded or prisoners need be looked for—all left behind are slain.

The cause of the disaster would appear to rest with those who left a brigade of troops 50 miles from their base, when an army was known to be advancing upon them. With regard to the fight, I do not see any blame to be attached to any one. The General marched out to fight when the enemy appeared in battle array. This is the correct thing in India; to retire is to bring every man of the enemy and every villager en route on one's back.

The battle having begun, the 36 Afghan guns being well managed, and also of a superior calibre, soon began to tell on our 6 horse artillery guns. Then followed the advance of 12,000 men against our 2,500, ending in a rush of swordsmen. It is said to be one of the most stirring sights to see the onward rush of 4,000 or 5,000 of these stalwart hillmen, exactly as did the Highlanders of old. The two Bombay regiments of Native Infantry were shaken and fell back on the 86th, and it is probable that in less than five minutes afterwards a mixed, confused and retreating fight began, ending as we are told in little short of a total destruction.

It is now that the want of a railway to Candahar is felt. That reminds me that the Premier of Canada is in London attending to your great railway, the Pacific line. Some of your people argue that as this railway assists Imperial interests, England ought to assist in its construction. Nothing could be fairer, and I cannot help thinking that when the Royal Defence Commission delivers its finding, that Sir John Macdonald's hands will be greatly strengthened in his arduous task of forming a Company for your line, I have reason to believe that the Royal Defence Commission will dwell on the necessity of securing Esquimaux Harbor and the coal mine of Nanaimo against all comers. It has lately been pointed out in the London press that these valuable localities are, in fact, the terminus of Sir John Macdonald's Railway. I believe that Esquimaux will in time become an Imperial station of the greatest importance, and, therefore, it will have a strong garrison and dockyard, and the coal mines will also be protected. To carry out this, it is plain that the railway will be of the greatest possible use to the station, and that the latter will increase the value of the railway. The one will act on the other in the most beneficial manner. It is not easy, however, to let this be known through our press, and, therefore, to those who would probably take shares in the undertaking. The public must be educated up to the point, and especially in their

geography, which is sadly deficient. They are shrewd and sinister in England, and, therefore, a steady campaign should be inaugurated to educate the public eye to the point whence they can see for themselves that your great North-west is of infinitely more value to the individual Englishman than the heated deserts of India, where the bones of so many of their friends are bleaching in the fiery sun. Not that I am in the least an advocate for any reduction of our power in India, which is of such benefit to the toaming millions of that country, but because, as Byron said, we have "stomach for them all," viz: we can hold India and also people your North-west.

Our population is continually increasing, and it would seem a fortunate matter for us that your Ministers should come here and invite the surplus population to go and reside on your rich lands, and that a series of bad harvests should force the voices of your leading men upon the ears and interests of their hearers.

General Roberts, "Bobsey," as his friends call him, has marched for Candehar. He is a capital soldier, and has certainly picked the best troops we have, English and native, for his campaign. Still he ought to have more guns, especially heavy ones, but he no doubt has not forgotten this. Transport has to be considered; we must therefore hope that Guzni has not been re-armed and strengthened, and that he may not be forced to try a siege. It is thought that General Roberts will probably avoid the fortress by making a demonstration before it while his baggage and stores defile on the road to Candehar. As the General, then Colonel Roberts on the staff always appeared to enjoy himself heartily when visiting the officers' mess of my regiment in India, I took advantage of our friendship to write to him to Cabul and warn him against assassination. He is a short man, though active, and would stand a poor chance against a huge young mountaineer, active as a deer, and as practiced in the use of the dagger as a skilful surgeon in the use of his instruments. I warned him that to be protected by men with swords and guns was of no use for his protection, for while firing and hacking at the assassin the mortal injury would be done him, but that active and powerful unarmed men should precede and follow him always, with orders to lay hold of any suspicious individual approaching him. I had a most kind letter to say that he appreciated my advice, but that he had not moved in the matter in any way, but he observed that his staff had, and that whenever he moved he was partly surrounded by native foot soldiers, picked for personal strength.

Colonel Williams, of the Canadian team, has made himself popular everywhere. Last Friday he returned thanks for the auxiliary forces at the splendid banquet of the Fish Mongers' Company. His speech was truly a stirring one, and when he alluded to the Canadian forces, and the important position they occupy in the British Empire, he was received with loud and prolonged cheering.

Colonel and Mrs. Williams are now the guests of Lord and Lady Stanhope, at their beautiful country seat, Chiddingfold, Kent.

"VIEUX SABREUR."

New Books.

A very valuable work on military law—treating specially of the new army discipline act 1879, is being brought out by Major General, Royal Artillery, Professor of Military History and military administration at the Royal Military College of Canada, printed at Ottawa.

The defence of Great and Greater Britain, published by Ed. Stanford, Charing Cross, London, is from the able pen of Capt.

Colomb, late Royal Marine Artillery, is perhaps the warlike voice of the day, if it is only listened to by English men on all sides of the Atlantic and Pacific. The author Capt. Colomb is one of four distinguished sons of the late General Colomb, one is in the Royal Navy another in the Royal Artillery, a third in the Royal Irish Constabulary, and the author himself in the Royal Marine Artillery, and have ably served the Empire with sword and pen in every quarter of the globe.

Defence of Great and Greater Britain.

To solve the problem of Imperial and Colonial Defence, the question must be answered, "what are the general principles on which the defence of the Empire must be based?" Captain Colomb says:—

1st. That it is of vital importance that the safety of the Imperial communications be secured,

2nd. That it is essential to the military strength of the Empire that forces created or existing for the defence of one portion be not so constituted as to preclude the possibility of using them in the defence of another.

If the Imperial communications are not secured, our enemy can make it *physically* impossible for the several parts to afford "mutual assistance when attacked." On the other hand, although they may be tolerably safe, if the military forces of each part are by law so constituted as to preclude the power of removing them to another, we ourselves render it a *moral* impossibility for the several parts to afford "mutual assistance when attacked." In the one case the enemy cripples the necessary power of concentration; in the other we save him the trouble by doing it ourselves. What then becomes of the military value of forces constituted as our militia and volunteers are, at home or in the colonies, when weighed in the Imperial scales?

If the Empire is to be defended at all we must apply on a large scale the ordinary and common military principle applicable to the defence of all territory, large or small.

The fundamental principle is briefly this. The success of all operations of war, whether defensive or offensive, depends upon the disposition of force in such a manner as will best secure the base of operations, and ensure safety and freedom of communication. It is useless to do one without the other, for in the one case neglect to the rule must lead to a "lock-out," in the other to a "lock-up" of military force. Our former disposition of our force risked the "lock out" of military force by rendering the capture of the base impossible: our present plan endangers, nay courts, the "lock-up" of military force at the base by leaving our communications exposed and outposts undefended.

In the late war we saw first of all an attack upon the advanced position on the lines of communication; next the cutting of the lines of communication; and lastly, as an inevitable consequence, Paris fell.

The United Kingdom is our Imperial base. The Imperial main lines of communication are:—

1. To British North America across the North Atlantic.
2. To the West Indies.
3. To India, China, and Australasia by the Mediterranean.
4. To India, China, and Australasia round the Cape.
5. From Australasia and the Pacific round Cape Horn.

It is just one of those things which "no fellow can understand" that the originator of the "Defence of Great and Greater Britain" has not been implored to sit on the Royal Commission, except that he has sat on it already by forestalling all it can say, for without any sort of representation from the Colonies the question of payment for the Imperial paper cannot be decided. We are evidently the same fat-witted Saxons so deficient in organization that we lost England to a handful of Normans after one battle, and the thin Norman stream has perhaps spent itself in watering the world to build up an Empire we desire to drift out of.—Ed. C. M. REVIEW.

The Imperial base can be reduced in two ways:—

1. By direct assault: invasion.
2. By indirect means: investment.

It is curious—I trust I may be forgiven for saying it—that while the possibility of invasion is not generally disputed, I believe I happen to be the only individual who believes in investment; at least I know of no other who has for eight years tried to force on public attention the fact that the certainty of investment, partial or complete, follows the possibility of invasion as surely as night follows day.

Consider for one moment on what the presumption of possible invasion rests. It rests on this—the loss, temporary, or permanent, of the command of the waters surrounding the British Islands. But remember that the lines of communication *all* radiate from these waters; the loss, therefore, of our command *here* cuts every one of the Imperial lines; and what is this but investment?

The statesman who could, in a magazine, speak complacently of an opposing force “scouring our coasts at twelve, fifteen, or sixteen miles an hour,” must surely have forgotten that the heart of the Empire thus cut off from its sources of supply must cease to beat. Hardly a mile could be traversed in triumphant defiance without injury, in a greater or less degree, to some artery or nerve, producing in some far-off member of the body politic of the Empire results more or less disastrous. It might be but a nervous tremor produced by a temporary disarrangement of the free course of trade, or it might be a paralysis caused by a prolonged interruption of the vital powers of communication. The question of results is but a question of time.

As regards the safety of communications, it must be borne in mind that the greatest danger to which they can be exposed is that which threatens the greatest number at one and the same time. Geographically speaking, this can only happen at the point of convergence or radiation, which in our case is the Channel.

Of what avail is it if our colonies, though protected in their own immediate neighbourhood, are “locked-out” from the mother country by a force in the Channel, against which we are unable to contend? Of what use is it protecting our commerce on distant seas if it is to be destroyed within sight of the shores of England? Surely, in reckoning up our means of defence, we should not forget that if our enemy confines his operations to an attack on our communications, and we are unprepared to resist it, the forces we have created for repelling invasion will be after all but a harmless host of a ruin they are powerless to avert.

I do not for a moment underrate the immense importance and absolute necessity of being prepared to render invasion impossible by purely military forces. If we are not so prepared we stake the fate of the Empire on, perhaps, a single naval engagement. A temporary reverse at sea might (by the enemy following up his advantage) be converted into final defeat on land, resulting in a total overthrow of all further power of resistance. It is necessary for the *safety of the Channel* that invasion be efficiently guarded against, so that should our home fleet be temporarily disabled we may, under cover of our army, prepare to strengthen it to regain lost ground, and renew the struggle for that which is essential to our life as a nation, and our existence as an empire—the command of the United Kingdom.

But the defence of our communications is not secured by the mere presence of sufficient naval force at home or in the Mediterranean; for as there are two modes of attack on the United Kingdom, so there are two ways in which our lines of communication may be destroyed. 1st. By direct attack on the point of convergence. 2nd. By a variety of attacks on one or more lines at points far removed from the place where they all meet. Assuming provision for meeting the first to have been made, I will now deal with the means to be adopted to meet this other mode of attack: and this is the most interesting portion of my subject.

Communications, whether sea or land, whether long or short, can only be secured by a firm grasp of the points which command them. The greater the extent of the line, the greater is the number of defended points necessary for its safety. In order to cut a line of communication, the first thing to be done is to seize the point which commands it, and in defending a line the point which commands it is the last to surrender. Such points are the minor bases of operation of forces acting in defence of the line. The relative importance of such points to the line, and to each other, can only be estimated by the circumstances of their geographical position and their distance from the main base from which the line springs.

It is now time to ask what are these points? and, in an attempt to reply, I take each line separately:—

1. The line to Canada. The only point here is a terminal one—it is Halifax.

2. To the West Indies. Here we have Bermuda, the Bahamas, Jamaica and Antigua. The strategic value of Bermuda is in some degree understood. The military value of Bermuda is in some degree understood. The military value of Bahamas was fixed by Sir John Burgoyne. Jamaica, from its central position and capacious harbor, is of considerable importance. I add Antigua for two reasons—(1) because Jamaica is far too leeward to be a coaling station or arsenal for cruisers acting in the defence of communications to the Eastern Islands; such vessels would burn a great quantity of fuel in steaming up to their station from Jamaica against the trades; (2) vessels bound for the greater Antilles and Gulf of Mexico generally pass between Antigua and Guadeloupe.

3. To India, the East, and Australasia, by the Mediterranean. The points here are Gibraltar, Malta, Aden, Bombay, Cape Comorin, and King George's Sound on the main line, with Trincomalee, Singapore, and Hong Kong on its northern branch.

With the development of the resources of India, Australia, New Zealand, and a host of smaller possessions, the necessity of securing their roads increases; so also increases the power of providing and supporting adequate means of defence. With a Russian sea-board on the one hand, and an American sea-board on the other, it cannot be said by their remoteness from us they are removed from danger of attack; nor must it be forgotten that the very fact of their distance adds to our difficulties in defending them, unless by a judicious combination of Imperial resources.

To attempt to determine the exact site for such a reserve naval arsenal for the Eastern portion of the Empire would be beyond the scope of this paper, but considerations respecting climate, and its effects on stores, &c., point to some port in Australia, as best adapted for the purpose.

4th line: To India and the East, and Australasia, round the Cape.

5th line: From Australasia and Vancouver's Island, round Cape Horn.

On looking into the subject, I have been much struck by the entire want of Great Britain of any advanced position in the Pacific Ocean.

In the selection of the points the following conditions should be fulfilled:—1. They must be in our possession, and on or near a line of communication. 2. They should possess natural advantages, such as safe and commodious shelter for the royal and commercial fleets, easy of access, and capable of defence. 3. They should be as far as possible the natural rendezvous of all times of vessels passing and repassing along the line, and the chief, if not the only, coaling station of the district they command.

Too much attention cannot be paid to the selection of coaling stations of the Empire.

It is our boast that we are at least secured from invasion because we have 100,000 regular troops at home, but when we are threatened with invasion, we are in imminent peril of investment. As the regular army is the only military force that can move, it clearly follows that, if 100,000 or any large

portion of that number of regular troops are necessary to guard against invasion, no force is available for garrisons of places on which the safety of our communications depends. The command of the sea is nothing more or less than the command of the Imperial roads, the securing of the first lines of colonial defences.

It is important to observe that there is no proportion between the force used in the interruption of sea communications, as compared with the amount of force required to secure them. To cripple the action of a single steamer we find it acknowledged, by one who ought to know best, that several cruisers would be required at certain points. A regular attack upon sea communications, therefore, involves the employment of an enormous force in their defence; and as the stations and positions are necessarily filled, so must bases of operation be at hand to supply the wants of that defending force.

The lines of colonial defences may be thus summarized:—

1. The defence of their communications, which involves fortifying the Imperial strategic points, and the existence of a purely naval and a purely military force; the one equal to the task of keeping open the roads between the points, the other sufficient to secure those points from capture in the necessary absence of the fleet.

2. The interior line of sea-defence, which must provide against the destruction, by bombardment from the sea, of naval resources at the strategic points in cases where that object cannot be secured by land batteries and military force. It also includes similar provision for the protection of colonial mercantile ports to prevent their commercial reduction by enormous requisitions.

3. The defence of the soil of all colonies and places not necessary to the Empire as military and strategic positions.

Having thus briefly viewed the nature of our requirements, it is desirable to draw some practical conclusions as to how they can best be met.

The communications of the Empire being the common property of all its component parts, each portion according to the use it makes of them, has a direct interest in their defence, and should contribute to that object.

The forces intended for the defence of the communications must be Imperial, and not colonial. They must be prepared to act at any point on the Imperial lines where they may happen to be required. Naval colonial volunteer forces which may be created under the Naval Defence Act of 1865 are only of value, and that to a very limited extent, to meet the necessities of the second or interior line of colonial defence.

The forces necessary for the defence of the Imperial communications should be under the control of one directing head.

If the colonies are really in earnest in matters relating to their defence, it is time they should combine to force on the attention of the Imperial Parliament the neglected state of the Imperial roads, and the necessity for devising adequate means for their security. They must, however, be prepared to bear their fair share of the burden.

With the creation of Imperial fortresses commanding the Imperial roads would grow up a feeling of common security. They would be links in the chain which binds together the military forces of our Empire; stepping stones by which those forces can cross to afford mutual assistance and support.

It would be easier in a given time to collect forces from all parts of the Empire at a given point now, than it was to concentrate the military forces in the United Kingdom on any particular place on the coast line sixty years ago. It is singular that when science has done, and is doing, so much to increase our power of concentration, Imperial policy should be undoing her work by persisting in the creation of local forces which it is impossible to move, and all this at a time when concentration is the great principle of attack, and the power of concentration is the great power of defence. Though by nature and by science we possess all the physical means necessary for the concentration of military forces, we have neglected to turn them to account, and further, by limiting the action of military

forces to the particular portions of the Empire where they are raised, we wilfully destroy the necessary power of resisting concentrated attack by a combination of Imperial resources; which is in these days the true source of strength.

It is only in maintaining the second line of colonial defences that local forces are of real value, but it is the duty of the Empire to see that they are provided with the means and weapons to enable them to act. For the first and third lines they are of no avail, so long as the necessary power of concentration at the weakest point is absent. It is military necessity, and not constitutional law, which determines where the greatest power of resistance is to be applied.

While we acknowledge and applaud the principle, that it is every man's duty to defend his home, it is to be regretted that our ideas of its practical application are lamentably indistinct. The mother country has put her own construction on the word "home," in applying the principle of calling into existence military forces which can only be used to put up her shop shutters and to bar her doors. She calls on her children to adopt her definition of its meaning and to follow her example, and some have done so. But who among the armies thus organized, for what she is pleased to call "home defence," can determine the exact distance from a man's home at which the obligation ends? Who can draw the magic circle which is to include the territorial area of his duty to die for his country? Home is something more than an abstract idea having reference only to locality; its foundations are laid in common interests, nor can miles of ocean sever the strong ties of affection and of sympathy. Hence it is that from whatever quarter of the Empire a cry for help comes—wherever the British flag waves over Englishmen struggling on their own ground for all they hold dear—it is there our home is in danger, there is the rallying point of forces created for its defence. While we boast of armed hosts here and in the colonies, whose proud motto is "home defence," they must "survey the Empire" to "behold our home."

(To be continued.)

Militia Items.

—The Inspector of Artillery has received a cable gram from England announcing the successful trial of the new Palliser 7 inch breech loading gun.

—General Luard, accompanied by Col. Van Straubenzee, D. A. G., inspected the 15th Battalion at Belleville on the 26th ultimo.

—The Major General Commanding inspected A. Battery, R. S. G., at Quebec on the 30th ultimo, and proceeded to Clifton, Ont. the following day.

The annual inspection of the Montreal Field Battery took place on the 21st August at the Exhibition Grounds. At half-past ten precisely Gen. Luard and staff arrived on the grounds and the inspection was proceeded with. Lieut.-Col. Irwin, Inspector of Artillery for the Province of Quebec, was the inspecting officer, and Lieut.-Colonels Fletcher and Amyrauld were the officers to call the roll, as it was a muster parade. After going through the different movements in an excellent manner, the battery was drawn up on the grounds and addressed by Lt.-Col. Irwin. He noticed, he said, a great improvement in the field movements, and he was gratified at the answers received to his questions about gun drill, etc., but on future occasions he would ask them many questions, and if they would study their manuals they would find no difficulty in answering. He expressed a wish to see all non-commissioned officers come to Quebec in winter for a two or three month's course in the school of instruction. They would then be able to properly instruct their men. He closed by expressing his pleasure to Col. Stevenson and the battery at the presence of General Luard.

Science in Heavy Gun Construction.

In our article last week we asserted that heavy guns lined with thick steel tubes, which latter have to support the whole of the longitudinal strain as well as the first shock of the transverse strain, are constructed in defiance of the teaching of science, and that they violate first principles.

The list of known explosions of steel lined guns without giving warning comprise the 100-ton gun at Spazza, one 38-ton gun on board the *Thunderer*, two 18-ton guns in France, one 9½-inch 18-ton gun on board the *Renown*, one 9½-inch 18-ton gun at Constantinople, two 9-inch 12-ton guns at Shoeburyness, one 8-inch 12-ton gun at Woolwich, one 8-inch 10-ton gun at Shoeburyness, one 8-inch 10-ton gun off Cadix on board the Russian frigate *Alexandra Nevelski*, one 7-inch 9½-ton gun on board one of H. M. ships at sea, two 7-inch experimental guns at Shoeburyness (15-pounders lined with steel), and two steel-lined field guns in India. Against this ugly list Sir William Palliser can point to the extraordinary fact that no gun lined with a coiled wrought-iron tube of any pattern, that has been introduced either by our service or adopted by other nations, has ever yet burst, whether at practice or at proof. We therefore feel justified in maintaining that he has proved his case. It should be remembered that six of the heaviest explosions took place very nearly within the last twelve months, so that the mildest possible powder, half the size of brick-bats, had then been made and issued, to spare the lives of these heavy guns, and money had been lavished to build them of the most costly materials, but neither the one nor the other has saved them from the inevitable consequences of a neglect of the rules of science. The sad story of the matter is, that six heavy guns—two English, two German and two French—having burst in about twelve months, when, and where, it may be asked, is the next explosion to come off? From a scientific point of view, we cannot see how there can be a sudden cessation of such accidents, and this makes the situation all the more alarming.

It is a positive relief to turn from these disasters and their originators—on the one hand manufacturers devoid of science, and on the other Government officials who know nothing of either manufacturing or science—to a scientific method of building up guns which knows no failure. As we have already mentioned in a former article, Sir William Palliser in constructing his guns throws the whole of the longitudinal strain upon the casing, or outside, of the guns, and absorbs the transverse strain by placing loose coiled wrought-iron barrels in the *middle* of the guns. About 2,000 of his guns, up to the 50-pounder, are in continual work at home and in the colonies, and none of them have ever burst in proof or in practice. The United States officers have carried out experiments lasting five years, and have definitely adopted the system we have described.

LONGITUDINAL STRAINS IN GUNS.

The bursting of the 100-ton gun on board the *Duilio* is a remarkable instance of the necessity of throwing the longitudinal strain upon the outside part, or casing, of a gun. In other words, it illustrates forcibly that this strain should be transferred from the lined area of the tube to the larger area of the casing; so, if there be 100 square inches bearing that strain at the inside of the tube, and if the diameter of the casing be twice that of the gun, then there would be 400 square inches, or four times the number of square inches supporting that strain when transferred to the casing. Thus if the longitudinal strain were to cause a total pressure of 4,000 tons, the pressure on the tube would amount to 1,000 tons per square inch; while, if transferred to the casing, it would only amount to 250 tons per square inch. The law enunciated by Sir William Palliser—namely that Barlow's law of transverse strains in a gun holds good for longitudinal strains too—is a question of first principle. The Ordnance Select Committee expressed their opinion 12 years ago that they were inclined to believe that Sir William Palliser was right. The subject is of sufficient importance to demand the special attention of the committee now sitting at Woolwich, and it is most desirable that they should have an opportunity of determining this important point.

Had Sir W. Palliser's law been understood, the *Duilio* gun would not have burst. Ignorance of that law has fostered four huge and dangerous monsters, namely four 100-ton guns, upon the country, at a cost, inclusive of carriage, mounting, and construction of ramparts, of probably £150,000. An inquiry ought to be at once instituted as to whether these guns are or are not safe in their present state, and whether boring up the steel tube and lining it on Sir W. Palliser's plan might not render them serviceable.

There can be no doubt but that the general belief existed that Sir W. Palliser's 7-inch gun would burst when it was fired doubly loaded. Surely the extraordinary strength shown by that gun, and the complete disappointment of all expectations as to the result of the experiment, ought to make our military authorities pause before they continue to lavish money upon attempts to bolster up steel-lined guns. They should remember that Sir W. Palliser was bitterly opposed for years with regard to the conversion of cast-iron guns, and that all the arguments now used against the extension of his system to large guns were employed against the conversion of cast-iron guns. The same authorities who opposed his most useful and economical converted ordnance, looked upon his now famous chilled shot as mere folly when he proposed them. "How," it was argued, "could such a wretched thing as cast-iron shot equal a steel projectile?"

It took some eight years before his armour bolts were understood and adopted in the Navy, and in our iron-clad forts. When the Admiralty adopted his bolts, the Lord-sent Sir William a letter of thanks, for he gave the Navy the use of his invention free from all claims; he has, in fact, never received anything for what otherwise might have been a valuable property. It is plain that Sir William has been for many years the unconquered servant of the War Office and Admiralty; but unfortunately for the interests of the public service, departmental jealousy—from which, however, the Admiralty are perfectly free—has been enabled to take advantage of the changes of administration, and to divert to office of new men, *ignara loca* has been the means of throwing absolute power into the hands of those who are inventors, manufacturers, and judges in one. The motto of the Ordnance branch of the War Office has, for too many years, *tria junta in uno*.

The past successes of Sir W. Palliser entitle his proposals to consideration; he maintains that if the stump of the gun which burst on board the *Thunderer* were lined on his plan with a coiled wrought-iron barrel, it would not burst if fired with a double charge similar to the second

Thunderer's gun into pieces. He founds his opinion upon experiments as shown in our illustration, and maintains that, though the barrel might bulge round the seat of the front charge, no further harm would ensue. He points to the fact that the first *Thunderer* gun is not bulged round the supposed seat of the front charge, as being one of the several proofs that that gun was not double-loaded when it burst. What we regard as especially objectionable is that while an experiment which would be of such infinite benefit to the service has been rejected on the score of expense, money should have been forthcoming by tens of thousands of pounds for purchasing 100-ton guns, which now must be dangerous because they have been constructed in ignorance of first principles. Since we have undertaken the task of endeavoring to elucidate these principles, we have shown two illustrations, which we trust will enable our readers at a glance to appreciate the difference between the application of science in gun construction on the one hand, and the lack of it on the other. — *United Service Gazette*

LECTURE ON THE PRINCIPLES WHICH SHOULD GUIDE THE CONSTRUCTION OF HEAVY ORDNANCE, AND ON THE MATERIALS FOR THE SAME.*

The construction of heavy ordnance is a subject which at the present time possesses especial interest in this country, because of the recent accident on board the "Thunderer."

I propose to direct your attention to the following divisions of the subject:—

- 1st. The nature of the force with which we have to deal.
- 2nd. The material which has to control and direct that force.
- 3rd. The proper disposition of that material.
- 4th. The arrangement for giving the projectile the necessary rotation.
- 5th. The effect of chambering.
- 6th. The proper arrangement of the material in the construction of breech-loaders.

1st. *The force with which we have to deal.*—This is the force of fired gunpowder. Many other explosive compounds have been proposed, but I believe it is now universally admitted that gunpowder is that which is best suited for artillery purposes.

Here, however, we are met with the fact that there are many varieties of gunpowder. These, however, as regards our own service, may be confined to R. L. G. and pebble powders, the latter being that which is now solely used in heavy guns.

The advantages claimed for pebble powders are that whilst they give as great or a greater muzzle velocity they cause less strain upon the gun than the R.L.G.

That they cause a less strain is quite true, and is due to the fact that they burn slowly and continue burning whilst the projectile is moving towards the muzzle.

It may, however, be shown that with a given weight of powder the mean pressure is less with a slow than a quick burning powder.

Taking the pressures in the 10-inch gun fired with 75 lbs. of pebble powder and a 30 lb. shot, of which a diagram is given in Messrs. Noble and Abel's paper on fired gunpowder (Phil. Trans. 1875), we find that with a maximum pressure of 18 tons per square inch, the terminal pressure at the muzzle was 3 tons, and the mean pressure about ½ ton per square inch.

Now when the shot reached the muzzle the chase was filled with gas at a pressure of 3 tons per square inch. If now that gas were forced back by a piston until it occupied the original volume occupied by the charge, and if there were no transmission of heat, which, as I will presently show, would be the case, the pressure would rise to 3.63 tons per square inch. But the work done in compression would be exactly equal to that given out in expansion, so that if the charge had been converted into gas instantaneously, the chamber would have been filled with gas at 3.63 tons, and that gas in expanding to 3 tons would have given a mean measure of ½ ton per square inch against ½ ton per square inch given by the pebble powder.

Roughly speaking, if the powder had been instantaneously converted into gas, the velocity of the shot would have been increased by twenty per cent, but this would have been obtained by an increase of pressure in the gun, from 18 to 3.63 tons, or about 80 per cent.

It is therefore evident that with the same weight of charge there is a loss of velocity with slow burning powder.

This appears to be borne out by the experiments recorded by the Committee on Explosives (Second Report, page 9), where the velocity obtained in a 12-inch gun with 85 lbs. pebble powder was 1,277 feet per inch, and with 67 lbs. of R. L. G., 1,157 feet per inch.

If the charge of R. L. G. had been 85 lbs., the velocity would have been 1,304 feet per inch, or about three per cent. greater than with the pebble powder, and a similar result would be obtained from the experiments recorded at page 10 of the Preliminary Report made with a 10-inch gun and charges of 60 lbs. of R. L. G., and 70 lbs. of pebble powder.

The difference of velocities between these powders is, however, so small that there can be no doubt of the wisdom of using the slow burning powder in large guns as at present constructed.

This being so, we may assume that we have for our motive power an elastic fluid attaining a pressure of 20 to 21 tons per square inch in guns of 12 inch diameter, and probably 30 tons in larger guns.

What regards us, however at present, is that we must provide for much higher pressures in large guns, even though we do adopt slow-burning powder.

The material of which the gun is to be made.—For heavy artillery we may leave bronze out of the question, and confine ourselves to cast iron, wrought iron and steel.

Much confusion of idea arises from the want of a really scientific nomenclature on this subject. By many writers, iron and steel are treated almost as though they were distinct metals, whilst the fact is that iron, whether cast or wrought, and steel, are in all their varieties only alloys of the metal iron with other substances.

*Lecture delivered at the United Service Institution by James A. Longridge, M.I.C.E.

All the innumerable varieties of properties, such as hardness, ductility, elasticity, tensile form, and resistance to compression, are due to specific mixtures of one or more substances with pure iron, and to particular modes of treatment in the process of manufacture, and consequently there can be no doubt that with exact knowledge of the various mixtures and complete uniformity in the process of manufacture, we would be able to produce with certainty any of the possible combinations which we might require.

How very far from this we still are, all practical men well know; but at the same time it cannot be denied that of late years enormous progress has been made, and that much of the uncertainty which obtained both in the manufacturers of iron and steel is now long away with.

It is practically impossible to draw an exact line between iron and steel. If we had a piece of pure iron, by adding to it carbon, we should form an alloy which would gradually acquire the property of tempering and become more and more fusible, and as we went on increasing the carbon, we should come to cast iron capable of being tempered but more and more fusible. Other substances added with or without the carbon will give alloys of other properties, and as I have said before, were our knowledge sufficiently extensive and our processes perfect, we could with unfeigned regularity produce the mixture we required.

I will not detain you with any detail of the properties of iron and steel as now used for ordnance, but will only advert briefly to two points of much interest.

The first is Sir Joseph Whitworth's process of subjecting steel to intense pressure whilst in the liquid state, whereby its consolidation is effected much more perfectly than by any process of forging. I have no hesitation in saying that for all purposes where a uniform quality, combined with great strength is required, such as is the case in the construction of guns, Sir Joseph's process is far preferable to that employed at Woolwich for the steel tube. It also ought to be more economical, since in the one case the tube is cast hollow, in the other cast, forged, and then bored out to the solid.

The other point to which I would advert is the effect of tempering in oil. Here it appears to me that we are sadly deficient of information. The experiments which have been made in this country show a great increase in the strength of steel tempered in oil, and under certain conditions an increased capacity before rupture, depending it would appear upon the temperature at which the cooling takes place.

But on this important question of the effect upon the modulus of elasticity and the limit of the elastic range, no reliable experiments have as far as I know, been made in this country.

From experiments in France we may deduce the following conclusions:—

1st. As regards the limits of elasticity, it appears that with bars of 11 mm. square the effect of tempering low steel of 0.157 per cent. carbon as to increase its limit of elasticity, if tempered in water 30 per cent., and if tempered in oil 40 per cent., whilst with larger bars of 25 mm., the increase was 32 per cent. in water, and only 7 per cent. in oil. On the other hand, with 1.650 per cent. carbon, the effect of tempering in oil was to increase the limit of elasticity by 103 per cent. in the small bars, and 135 per cent. in the larger ones.

2nd. As regards ultimate strength, the effect with low steel was an increase of 37 per cent. by tempering in water, and 33 per cent. by tempering in oil. Whilst with high steel of 1.650, the effect of tempering was to increase the strength about 50 per cent. The bars failed when tempered in water.

3rd. As regards the amount of stretching at rupture, the result of tempering with low steel was, when compared with the steel in its natural state, a decrease of 41 per cent. in water, and 23 per cent. in oil, whilst with high steel the effect of tempering was to reduce it from 80 to 98 per cent.

The bars of high steel containing 0.7 per cent of carbon and upwards, broke in the tempering when water was used.

It is often reported that the steel suitable for gun-making must be a low steel, because although a high steel acquires a much greater increase of the limit of elasticity, and a somewhat greater ultimate strength, yet its powers of elongation are very much less than that of a low steel.

But if by a proper disposition of the metal, we can insure the strain never exceeding a limit considerably within the limit of elasticity, then we might safely use a much higher carbonized steel and obtain the advantage of its highest elastic power and great ultimate strength.

Laying down as a first principle of construction that no portion of the gun should under any circumstances be strained beyond its elastic limit, we find that this limit is reached in low steel of 0.157 per cent. at about 32 kilogrammes per square millimetre, or about 30 tons per square inch, whilst the ultimate strength is about 30 tons per square inch.

On the other hand, with a steel of .709 per cent. carbon, the elastic limit is 43 tons per square inch, and the ultimate strength 65 tons per square inch.

It is not the first cost of the raw material that is to be considered at the cost in the finished state, and when we find that the actual cost of a 33-ton gun at Woolwich is £90 per ton, it is very probable that a gun of the same weight made entirely of steel would not be more expensive and would be greatly stronger.

When I come, as I shall do presently, to the question of construction, I will show that a gun of equal strength may be made much lighter of steel than of iron, and the dead weight required to meet the recoil may be made up of much cheaper material, so that in the steel gun may be made actually cheaper than the iron and very much stronger.

As regards wrought iron, there are so many varieties differing so widely in those properties that I can do no more than point out what are the main features to be attended to in the selection of iron for gun-making.

These are:—

1st. The degree of extensibility per ton per square inch up to the elastic limit.

2nd. The elastic limit itself.

3rd. The amount of stretching before rupture.

4th. The amount of permanent set.

It will appear when I come to treat of actual construction, that all built-up guns of high range or elastic limit is of primary importance, and whatever has been held to the contrary, I maintain that a great amount of stretching, if accompanied by permanent set, is a property to be carefully avoided in such guns.

This will be specially seen when I come to treat of Sir William Palliser's system where an iron of extensive stretching capacity seems to be preferred for the inner tube.

I now come to the 3rd division of my subject, the "proper disposition of the material," and I will deal briefly in the first place with the homogeneous gun, which in its usual condition is a solid gun made of but one piece, such as the ordinary cast iron, bronze or steel gun.

I do so, although I believe few people would now advocate making a heavy gun in this way, because it involves the fundamental principle upon which all built-up guns must be founded, viz., the problem of determining the exact condition of strain of any particle of a cylinder which is subjected simultaneously to external and internal pressure.

In the solid homogeneous gun the external pressure is only that of the atmosphere, and that is so small when compared with the internal pressure that it may be neglected, but in built-up guns it is only the external ring which is so circumstanced, whilst all the others have during explosion certain normal pressures at both surfaces depending first on the internal or powder pressure, and secondly on their relative dimensions previous to putting together and on the elasticity of the materials.

If these elements be known, the strains on every portion of the structure may be accurately determined, or on the other hand if it be required to construct the gun so that these strains shall not exceed a given limit, under any given powder pressure, then by the use of a proper formula the dimensions of the various parts of the structure required to fulfil this condition may be determined.

I wish to insist particularly on this because it is too often asserted that such formulae are of no utility in comparison with practical experience, a thesis which no scientific man can hear propounded without astonishment.

(To be Continued.)

CIRCULAR No. 41.

DOMINION ARTILLERY ASSOCIATION.

SHIFTING ORDNANCE COMPETITION.

Open to detachments from all Garrison Artillery Batteries affiliated with the Dominion Artillery Association.

The detachment to consist of 21 officers, non-commissioned officers and gunners.

A gun 50 cwt. or thereabouts, sights removed, mounted on a Garrison standing carriage, to be dismounted over the front of the carriage, and remounted on the same carriage by parbuckling on a single skid.

1st operation.—Gun to be raised out of the trunnion holes and slewed across carriage, then thrown over front by raising rear of carriage.

2nd operation.—Gun to be mounted up rear by parbuckling, one skid being placed between checks of carriage, slewed and lowered into trunnion holes.

Stores allowed:—

- One 10 feet lever.
- Eight handspikes.
- Eight scoches of sorts.
- One skid 14 feet x 8 in. x 8 in.
- Two skids 3 feet x 6 in. x 6 in.
- Two skids 3 feet x 4 in. x 4 in.
- Two parbuckle ropes.
- One drag rope.

Stores to be arranged—coins, etc., replaced.

The detachment mounting in the shortest time to be declared winner. The detachment must work by numbers and keep silence; one second in time will be deducted for every word spoken by any one of the detachment except the commander.

Prize to the detachment doing the shift in the shortest time, gold embroidered badge and handbook field service to the commander, twenty dollars to the detachment.

Commanding officers of corps from which detachments intend to compete, must notify the Secretary D.A.A., Kingston, before the 31st October, and the shift must be carried out in the presence of an umpire duly appointed before the 31st December, 1880.

T. BLAND STRANGE, Lt.-Col.

I. of A., President of Council.

Royal Military College.

The Royal Military College opens on the 15th. The new batch of cadets join on the 9th inst. The four gentlemen selected for the British army have not yet been gazetted to their respective corps.

	Marks.
A. B. Perry	42,285 R E.
H E Wise	30,350 Infantry
C O Fairbanks	29,562 R A
H. C. Freer.....	26,896 Infantry.

The Kingston correspondent of the *Broad Arrow*, very justly remarks of the whole batch of graduates of the first term, a finer lot of young fellows could not be found any where in Her Majesty's Dominion. It is to be regretted that Canada does not appreciate the value of her sons in this instance. Those who have not been promoted for in the British army, should be offered appointments in the public works department and employed in all Government surveys where there scientific education, the habit of discipline that always gives the power of command as well as the honorable feeling and integrity that accompanies a genuine military education, would make them invaluable servants to a poor country straggling with the lavish waste of money caused by political appointments to positions requiring professional knowledge.

The Tenth Royals.

A letter has been received by Col. Shaw, of the 10th Royals, from the Militia Department, Ottawa, disbanding the regiment. The notification to the commanding officer alluded to the difficulties which had at various times presented themselves to the Department regarding the discipline in the regiment, and the only course left open to the Militia authorities is to disband the Battalion. A new battalion will be raised in its stead, to consist of six companies, and to be numbered on the Militia Roll as the 87th Battalion. It is understood that Messrs. Rolph and Shaw will be offered the positions of majors in the new battalion, leaving a vacancy for a commanding officer. Many will regret the causes which led to the disbanding of the gallant Tenth, which at one time occupied a proud and honorable position on the Militia Roll. No doubt the new battalion will be composed chiefly of men from the same regiment.

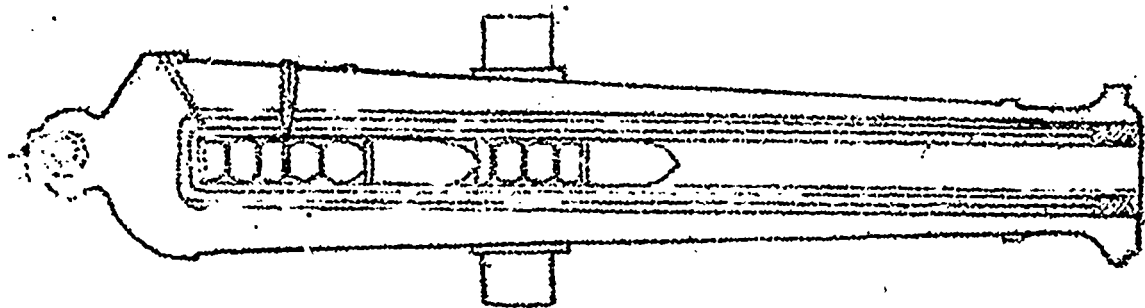
Military News.

—The last War Office *Gazette* announces the promotion of Sergeant Joseph Edward Anderson from the 6th Dragoon Guards to a second lieutenancy in the 19th Hussars. This is the ninth commission from the ranks during the present year, the cavalry carrying off five, while two non-commissioned officers of the infantry regiments of the Line have been promoted, and two promotions have taken place in the Coast Brigade. In the cavalry, twenty-six officers, exclusive of riding and quarter-masters, have risen from the ranks, eight now holding commissions as captains, whilst five are doing duty as subalterns, and no less than thirteen are adjutants of their regiments. Three regiments of the Line—the 1st Battalion 23rd Fusiliers, 50th Foot, and 75th Foot—are commended by officers who have risen through gallantry in action from the ranks, two out of their number wearing the Victoria Cross. In the infantry of the Line two majors, eleven captains, and twenty-two subalterns are now serving who have all commenced with the "Queen's shilling," and it may be noticed that for the first time in its history the Grenadier Guards counts among its lieutenants a former sergeant of Hussars. Lieutenant-General Clarke and Major-General Sayer, C.B., are now the only general officers who have risen from the ranks, whilst three colonels, ten lieutenant-colonels, and six majors on the active list have been equally successful.

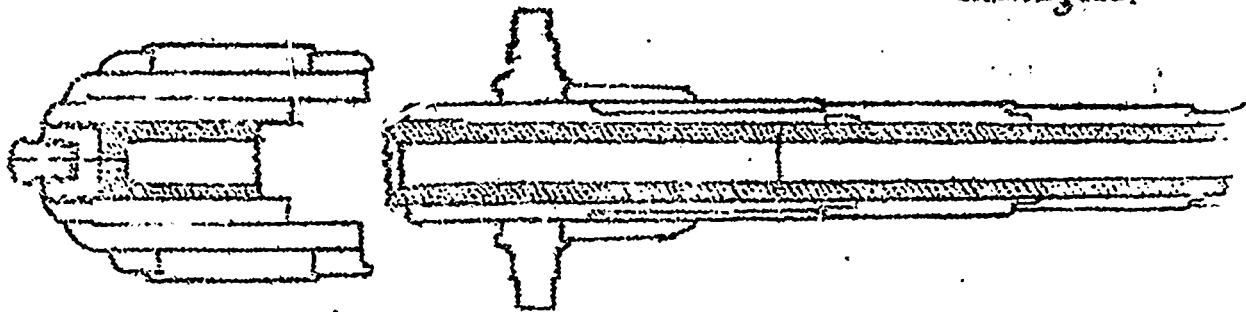
—Col. von Lobell, the editor of the *Militär-Wochenblatt*, the organ of the head-quarter staff in Berlin, says that in the English army the non-commissioned officers are still, to use the expression of the Duke of Wellington, "the backbone of the service"—since the education of recruits is carried on altogether by them, the officers exercising only a very general supervision over, and never coming into daily contact with their men, as is the case with other armies. Every intelligent foreign officer who studies the English military system is, Colonel von Lobell adds, struck by the fact that with the exception of the commanding officer and adjutant no regimental officer has any power over his men or manifests the slightest interest in the service. "When English officers have, says the German critic, "any duty to do they grumble; but if a sphere of activity were opened to them—if they were brought into close contact with their men, if they were allowed a certain amount of independence and initiative in dealing with their detachments, while the commanding officer contented himself with a general supervision without meddling in details—these same grumblers would vie with one another in the strict performance of their duty, and would devote their whole energy and time to their profession." It can hardly be denied that there is much truth in the remarks of the German writer.

—In answer to Mr. O'Shea, Mr. Childers stated, in the House of Commons on the 20th July, that in February last Colonel Hope, of the 1st Surrey Artillery Volunteers, and General Ripley, of the United States Army, made an offer to supply certain guns for the use of the Navy. In reply, these gentlemen were furnished with a copy of the regulations of 1869, a compliance with which was necessary before any arrangement was made with inventors. But they positively refused to comply with the first regulation, by which inventors were required to describe their invention. He held the strongest opinion that compliance with this condition ought always to be enforced, and he therefore confirmed the view of his predecessor. Mr. O'Shea said he should take an early opportunity of calling attention to a petition signed by Sir H. Bessemer, Professor Merrifield, and others, in which they stated that they looked with dismay at the condition of English heavy guns, and believed that unless something were done to place the country upon an equal footing with foreign nations in this respect, the national safety would be endangered. There were several systems of ordnance which were superior to the Woolwich system, but had not had a fair trial in this country in consequence of the jealousy of the Government in favour of their own system.

—The German military authorities have until very recently regarded the magazine or repeating rifle with disfavor, and have carefully abstained from encouraging those who sought to improve and perfect existing patterns of the weapon. The *Militär-Wochenblatt*, the organ of the head-quarter staff at Berlin, now admits, however, that the expenditure entailed by a rearmament of an army of the numerical strength of those maintained nowadays is the only valid objection which can be urged against the adoption of a repeating firearm. The armies of all the great European Powers, the *Militär-Wochenblatt* says, have been provided with rifles of practically equal power and rapidity of fire, and no one State can now claim for his forces a superiority in armament over another; but the moment any of the greater military Powers adopt a repeating small arm it will place itself in a position of decided advantage. The *Militär-Wochenblatt* combats the argument that the introduction of a repeating arm will necessarily lead to a wasteful and disastrous expenditure of ammunition. The same argument was used against the breech-loading rifle (and it may be added, prevented the adoption of the needle gun by the English and French Governments, to whom it was offered before it was introduced into the Prussian service), and yet no nation would now revert to a muzzle-loading system.



*Longitudinal strain shown in the casing. Pelletier fire, under
loaded gun.*



Longitudinal strain shown in the tube.