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ADMIRAL SIR FREDERICK W. E. NICOLSON, Bart., C.B.,
Chairman of the Council, in the Chair.

THE NORDENFELT MACHINE GUNS (PALMCRANTZ'S
SYSTEM).

By T. NORDENFELT, Esq.

TIME does not allow me to enter into the history and development of the Nordenfelt machine guns, which on the Continent are called the "Nordenfelt-Palmerantz" guns, the name of my clever friend Palmerantz, who originally invented the mechanism, and who still works with me at Stockholm in our common interest and object in developing and perfecting these machine guns, being added.

I may be allowed to state at once that I differ from those gentlemen who consider machine guns as competing with artillery. I hold them to be special weapons, invaluable for special purposes, mostly created by the great advance during late years in all other branches of the science of war.

The appearance of the first ironclad on the American waters was the signal for wooden navies to depart. The "wooden walls of old England" were no longer to be trusted; they had indeed become relics of the past, with a most glorious history but without a future.

The monstrous ironclad with her heavy ordnance would receive a full broadside from a three-decker with as little effect as a hailstorm would produce on the back of a tortoise, while she could cut the wooden ship into pieces with her ram. The ironclad seemed to reign supreme, constantly increasing in size, armour, and ordnance, until doubt was thrown upon the wisdom of having too large vessels by the appearance of a tiny foe, generated by science—a very scorpion of the deep—one touch of whose fiery tongue could send the noblest ironclad to the bottom of the sea.

The torpedo-boat had, therefore, to be met by special weapons, and machine guns came to the front ready to deal with it so effectually that a daylight attack now becomes almost an impossibility, and it

requires a stout heart to volunteer to attack in a torpedo-boat even at night.

Machine guns must also be acknowledged sooner or later as invaluable against the modern swift unarmoured ships which, with their speed of 15 to 18 knots, give but little chance to the present recoil guns.

In the Army also there has been an almost complete revolution in the weapons of warfare. The weapons used by Wellington are obsolete. Rifled cannons have increased the precision and effect of projectiles to an extent previously unknown, and at the same time they have enabled artillerists to fire at enormous ranges.

The rifle has given the same advantages to the infantry; and still the repeating, or magazine rifle is pressing on the ordinary breech-loader. It has, however, yet to be proved that for general service with deliberate aim, when the target is an enemy for each shot, the ordinary breech-loader is not, on the whole, more satisfactory; while when firing against columns or moving bodies of infantry or cavalry, or against earthworks or parks of artillery, the light, small-bore, machine gun must be by far the most effective.

I look upon machine guns as mechanical contrivances for economizing human labour and human life in war. They are to the art of war what Arkwright's spinning jenny was to weaving. He enabled a few people to produce as much yarn in an hour as scores employing the "turn" with its single spindle could make in a day—and even the turn was a great advance upon the distaff. The machine guns have, for special purposes, the same superiority over the breech-loader, the old Enfield rifle, and "Brown Bess."

The men at Crecy and Agincourt fought with the long bow, which could strike a target at six score yards; but these heroes would, even with the Black Prince to command them, have been practically defenceless against the "Brown Bess" in the hands of the poorest of disciplined troops.

The man who invented the sling that would "throw a stone to a hand's-breadth," put a weapon into the hands of the lad David which made him a match for the giant—terrible fellow though he was.

All experience, especially of the last 20 years' wars, tends to prove that the best weapon does as much or more to secure victory as the best man; and that the best armed man is often master of the situation under very adverse circumstances, and is always the conqueror if his discipline is as good as that of his enemy.

The supposed difficulty of supplying ammunition for a machine gun in the field is not great—always granting that the gun uses the same ammunition as the rifle; because for most purposes for which a machine gun would be used, it would fire at spurts of only a few seconds at a time with so much more effect, both actual and moral, under these special circumstances than ordinary rifle firing, that the total ammunition fired from the machine gun would probably not exceed what would have to be fired by the corresponding number of rifles before the same object were gained.

The Turks, moreover, during the late war gave a severe lesson

to those who would retard the development of arms for fear of the difficulty of supplying ammunition, by proving that even with their inferior organization and miserable transport, the supply of ammunition can always be relied upon, as soon as the paramount importance of this supply is fully understood.

The question of expense for a country like England is also relative, for if machine guns can shorten a war by a week, or can prevent the blockade of a single colonial port, the possible expense for extra supply of ammunition must be repaid tenfold.

General Description of Machine Guns.

In order to give a clear description of the guns generally, I must divide machine guns as seen from two different points of view:—

First.—(a.) Machine guns with revolving barrels which cannot fire volleys. (b.) Guns with fixed barrels, and which can fire either volleys or single shots as desired.

Second.—(I.) Machine guns firing the same projectiles as the rifles of each country. (II.) Machine guns firing projectiles of larger calibre than rifle calibre, principally for the purpose of penetrating ships' plates, boilers, &c.

My machine guns have fixed barrels, and can always fire volleys, unless any Power prefers to submit to single-firing for the purpose of gaining lightness and simplicity. They are also equally well adapted for small and for large calibres.

The Gatling gun is the original type of the opposite system with revolving barrels, which cannot fire volleys, and I hope that Dr. Gatling will excuse my saying that his revolving gun, with movable breech supports, is tied down to the first part of my second basis of division, viz., that his gun can only fire rifle ammunition with advantage. The Hotchkiss gun¹ is a development of the Gatling idea with revolving barrels, and cannot fire volleys, but with his solid breech support he has gained the point of being able to fire projectiles of large calibre; while, on the other hand, he has lost rapidity of fire, so that his system is impossible for rifle ammunition. Mr. Hotchkiss, therefore, naturally condemns all machine guns which fire rifle ammunition, and brings his large experience to bear upon competition with artillery in firing shells.

The Gardener gun lies between the two in the first division. It fires with fixed barrels or rather barrel, but it cannot fire volleys; and I believe that it only fires rifle ammunition.

I would, however, hardly class the Gardener gun with machine guns, because the single-barrelled gun which Mr. Gardener himself especially recommends is rather a clever repeating rifle, while it at the same time requires the full service of men and equipment of a machine gun.

Of all other machine guns such as the Montigny, the Albertini, the Lowell, the Trotter, the Rowbottom, and numerous others, I can only say that some are like flowers that have already withered and belong

¹ See Journal, No. CV, p. 279 *et seq.*

to the past, while others still show only in the bud without any immediate prospect of coming into bloom.

I must apologise for thus bringing in the leading features of other guns, but I have thought it necessary, in order to illustrate the principal points in which we differ, and I now proceed to describe the mechanism and use of my own gun.¹

In the Palmerantz system the barrels are fixed in a level line, or in an arch, the breech supports are brought forward to the barrel chambers, pushing the cartridges in front of them, then the breech is locked, the cartridges fired, the breech unlocked, and the fired cartridge cases extracted by the retiring breech plugs. The fresh supply of a layer of cartridges is provided by the cartridge receiver, which by a traversing motion carries the cartridges from the compartments in the feed case, which correspond to the barrels, into a line with the rear of the chamber, ready to be pushed in by the next forward motion of the breech plugs.

The cartridges are kept in hoppers or feed cases, with one compartment for each barrel, so that I can at any time control the fire of each barrel. When continuous firing is desired, the hoppers are double, so that the upper hopper is changed, while the contents of the lower hopper are being fired.

The entire movement of the mechanism results from the forward and backward movement of the firing handle, so that one single gunner can fire without any assistance with his right hand rapidly an entire hopper full of cartridges varying from 40 to 200 shots, while his left hand is free to attend to the elevating and traversing gear. The trigger comb is locked during the forward and rearward motion of the firing handle, so that no shot can be fired when the springs are compressed until after the recoil bolts have locked the action block and breech plugs. This locking of the trigger comb is a recent modification, in order to make the guns quite safe from premature explosions of cartridges.

The guns can fire single shots or volleys as desired; when firing single shots, the recoil is very slight indeed, and when firing volleys, the shots are not fired absolutely at the same moment, but follow one another extremely rapidly, so that the recoil of a volley has only about two-thirds of the effect which it would have if the shots were fired absolutely at the same moment. The recoil bolts which lock the action block, when in firing position, bring the recoil to bear upon the entire frame and mounting of the gun, so that the total weight of the gun is sufficient to resist the recoil, always supposing the gun to be properly fixed to its mounting or carriage.

For land service we have applied an automatic scattering motion, which can be adjusted in order to spread each volley horizontally along the front of the enemy at varying ranges.

The mechanism is made of the very best forged steel, and all the parts are so amply strong for the work they have to perform, that no breakage is likely to occur.

The cartridges, which fall straight into the cartridge receiver, have

¹ For full details, see Plate and Appendix.

only to travel their own length into the chambers and out again, and the empty cases drop, from their own weight, out of the cartridge receiver, so that with the comparatively slow movement of the mechanism no jams or hitches are likely to be caused by the mechanism. In case any hitch should be caused by an imperfect cartridge, I have only to raise the cover by pressing the spring-lock with one finger, when the mechanism is laid bare so that I can touch at once every firing needle and extractor, and so that I can remove the cartridge or clean the chambers, which are then so open and accessible, that I can put my finger right into all the barrels from the breech end as well as from the muzzle end, and can clean them from either end.

The entire mechanism can be taken out of the gun without a single tool in a few seconds, and the spiral springs can be taken out in a moment, and replaced without any tools and without even raising the cover or opening up of the mechanism. As a separate cocking piece has lately been added to the gun, the hammers have now nothing more to do than to strike the firing needles, and the hammers and spiral springs are now so amply strong for the work they have to do, that no breakage of any kind has occurred even at the excessively rapid firing during the last few months at Portsmouth and at Shoeburyness.

If a faulty cartridge case should fail to be extracted and remain in the chamber, the remaining barrels can still be fired without any stoppage, by a slight double motion of the handle, which throws out the cartridge which corresponds to the barrel which is disabled, and if one or more barrels are damaged in transport or by the enemy's fire, the remaining barrels can still be fired, because I can control the compartment in the hopper belonging to each barrel, so that I only have to fill the compartments corresponding to the barrels which remain in good condition.

As the breech plugs close up from the rear, in line with the chambers, this gun is much less affected by possible dirt or fouling than guns where the breech closes from the side.

The mechanism itself is well covered, but the cartridge carrier is open both above and below, so that no dirt can collect in it to prevent the easy run of the cartridges, and I hold this to be one of the principal advantages, that it is unlike the revolving guns, where the chamber-ends of the barrels and the entire breech are covered up and not easily accessible.

I wish especially to point out that the fact of our system having fixed barrels is very advantageous, not only because it saves the work of revolving the barrels, but also because, when we come to larger calibres, we can use heavier charges of powder per calibre, without unduly increasing the weight of the gun; whereas in a revolving gun, with barrels of large calibre, and with heavy charges of powder which necessitate considerable thickness of steel in the barrel, the pressure of the explosion of the cartridges acts so far from the centre of the revolving motion, that all these parts must be made especially strong and heavy in order to prevent their being bent or upset, which would

hinder the smooth action of the two revolving surfaces, viz., the chamber base and the face of the breech.

Dr. Gatling has seen the importance of this, and has provided a regulator for adjusting the distance between chamber and breech; but this regulator is, on the other hand, rather a source of trouble, and it requires great judgment on the part of the gunner; and if used incorrectly, might throw the gun out at an important moment.

Calibres.

We make machine guns of the following calibres:—

(a.) *Rifle calibre*, varying from 0.33 to 0.56 inch, and we have made such machine guns for the Martini-Henry, Snider, Peabody, Gras, Mauser, Berdan, Wetterli, Remington, and Comblain cartridges, varying from 5 to 10 barrels in each gun; the weight of these guns varying from 100 lbs. to 260 lbs., depending principally upon the number, length, and weight of barrels with corresponding varying strength of frame and mechanism.

(b.) *1-inch calibre*, specially for naval use for defence against torpedo-boats. We make these with four barrels, like the English naval 1-inch gun, weighing 4 cwts., or with two barrels, weighing about $2\frac{1}{2}$ cwts., the latter more especially for use in the tops and in boats, for which purpose the mounting is so arranged that the gun can be easily and quickly moved from one place to another.

(c.) *$1\frac{1}{2}$ -inch calibre* for general naval use for firing $1\frac{1}{2}$ -lb. shells against unarmoured vessels, and for field service and fortifications.

We make these with one barrel when the gun weighs 2 cwts., and with two barrels when the gun weighs about $4\frac{1}{2}$ cwts.

We have also in work a $1\frac{3}{8}$ -inch and a 3-inch gun for firing respectively $3\frac{1}{2}$ and 12 lbs. projectiles, but these are not yet so far advanced that I can give any definite details.

For Field Use

there are two entirely separate kinds of machine guns: the one is a *shell-firing gun*, which would compete with field artillery, which Mr. Hotchkiss has worked out with a certain amount of success. As to this I can to-day only say that I hope shortly to be in a position to show that the effect produced by the Hotchkiss gun can be produced by a smaller number of fixed barrels and lighter weight of gun, when the advantage might perhaps be held out to the artillery that the same weight of metal in the shape of small shells, spread more evenly over a surface, may be thrown per minute by a gun of smaller calibre and light weight than what is now done by the present light field gun; on this point, however, I do not speak at the present moment with much confidence.

The other kind of machine gun is the much-abused small-bore battery gun or mitrailleuse, as representatives of which I take my ten-barrelled gun, which weighs $2\frac{1}{2}$ cwts., and fires 110 Martini-Henry bullets in five seconds, and my five-barrelled gun, which weighs from 110 lbs. to 135 lbs., and fires 70 shots in five seconds.

The ten-barrelled gun is of course the most effective, but it requires two horses for gun and limber.

The heavy machine gun got into sad disgrace during the Franco-Prussian War, when the old Montigny was outlawed—but then it must be remembered that the mitrailleuse of that day fired slowly, and not continuously; that it weighed three times as much as mine, and that it consequently required six horses. It could not be moved quickly, and its tactics consequently exposed it to be destroyed by the enemy's field guns. It also had the fatal fault that it required a special cartridge, so that often when the mitrailleuse was relied upon by a General it was worse than useless if the wrong ammunition had been brought up; besides which, a second kind of small arms ammunition in the field also created confusion in the supply of cartridges to the infantry.

This is one reason why I think it hopeless at present to introduce a machine gun which fires small shells in competition with the present field guns, because this would introduce a new kind of ammunition, whereas my ten-barrelled gun would fire the rifle ammunition which already is in the field, and would prove invaluable in the hands of tacticians and strategists, who understood how to make use of a weapon which, from one point and under cover, fires an exceedingly rapid succession of volleys, each volley of ten shots being spread over a surface which I can adjust by the automatic spreading motion as desired.

Within a range of 1,500 yards a gun could hardly be brought up to destroy the mitrailleuse in face of the heavy rain of bullets.

The question of the use of these ten-barrelled guns in the field will probably require further study and consideration, but there can be no doubt that for the defence of bridges, roads, and temporary intrenchments, they must be most useful.

An entirely new phase in the use of mitrailleuses has, however, been opened up by the small five-barrelled gun which weighs less than one-third of the service Gatling gun, while it fires much more rapidly, say about 500 rounds per minute, or, for spurts of 100 shots at the time, at the rate of nearly 800 shots per minute.

This gun with its limber on wheels can be drawn by one mule or by three men; it can be carried on one horse, with the trail on a second horse, or the gun and pivot can be carried all on one horse; when required, the gun and pivot can be carried on the shoulders of three men, who also carry the ammunition in special knapsacks.

This gun has nothing to do with artillery at all; it is simply a combination of five repeating rifles, with magazines, fired by one man: it gives a General the best chance of a mounted infantry which can be sent forward quickly in advance to occupy points of vantage, or which in retreat can hold on to important points to give the infantry time to retire, step by step; for attack as well as defence of baggage trains and convoys of ammunition it would also be useful.

A troop of cavalry with a mounted machine gun could do much in harassing and in surprising an enemy on the march, and a clever Officer with a couple of machine guns on horse-back could generally

creep up near enough to an enemy to have a few seconds' destructive fire at the cavalry or artillery of the enemy.

These guns would also be useful for dropping fire against trenches, and for defence of intrenchments or of an open camp: they could be kept close at hand, and be brought into play at the all-important moment when the enemy storms the position. A glacis defended by mitrailleuses could hardly be stormed at all, and a breach could not be passed against mitrailleuses under cover with cross-fire into the breach.

I cannot but think that it would be specially useful in colonial wars against hordes of undisciplined natives, for hill work, and for defence of dépôts, camps, and laagers.

I have mentioned a few of the many special occasions when I think that a mitrailleuse firing the same ammunition as the rifle would be useful, independently of artillery, and I leave it to Officers who have commanded in the field to consider how far it would be advisable to provide such weapons for these special occasions; as no special ammunition is required for them, it would not be very difficult to let a certain number follow each brigade.

For Naval Use.

I begin with the small-bore machine gun, and here again there is use for both a ten-barrelled and a five-barrelled gun.

As these guns use the same ammunition, and as the system is the same, it is no disadvantage to have both guns in the Service, because every sailor who can fire the one can also fire the other.

On large vessels two ten-barrelled guns in fixed position on deck would be most effective for sweeping the decks of an enemy's vessel.

Its volleys of ten shots each with the slight vibration of the gun would have sufficient spreading without any scattering motion; the angle of descent at long ranges, and a few rapid volleys at shorter ranges when the enemy's ship heels over, would be most effective, and a steady succession of volleys of ten shots at his gun ports would disturb the service of his guns.

All the faster unarmoured vessels and all gunboats, where there would be no question of moving the guns from one place to another during action, could also have one of the ten-barrelled guns, as well as their complement of larger calibre machine guns.

The five-barrelled guns, again, would be fitted to the tops of all larger vessels and in steam launches, and generally where they are required to be moved quickly from one point to another during action. They might also be fitted to torpedo-boats for firing against other boats, against anti-torpedo guns during attack, and against the electric lights of the enemy's vessel the moment they are found out, and previous to or during the actual attack.

I have not liked to say much about what these guns have done, because they are still under the consideration of the Machine Gun Committee, whose experiments will be continued as soon as we shall have completed new guns for the new ammunition decided upon by the Committee, in lieu of the present service ammunition, for which latter the guns were first made.

I think, however, that I may say that my guns have done at least as well as those of my competitors, and that I can therefore offer one and the same satisfactory system throughout all the calibres required by the Navy.

While I am fully aware it would be wrong to lose any one advantage on board for portability and convenience ashore for naval guns, still my small five-barrelled gun is so very suitable for landing purposes that this should not be lost sight of. Three sailors can pull the gun and limber; four sailors can carry the gun and trail in case the wheels have to be left behind; and the ammunition is kept in knapsacks in the limber, ready to be carried wherever the limber cannot be conveniently taken. With six or eight men this gun would be as well served as the Service Gatling with 18 men, and it fires more quickly, and is much more simple and not likely to jamb.

Anti-torpedo-boat Gun.

For this special purpose it is quite clear to me that the right calibre is the smallest calibre which gives sufficient penetration, viz., 1 inch; because the smaller the calibre, the larger the number of barrels that I can use in each gun, the greater number of shots I can fire in each volley, with correspondingly greater chance of hitting, and the more I can increase the actual rapidity of fire as the range against an attacking torpedo-boat gets shorter, and the effect of each bullet proportionately greater.

I look upon volley firing as an absolute necessity for naval machine guns, as long as the consideration of weight or portability of the gun does not make it necessary to submit to single shots. It is quite true, for instance, that the Gatling gun can give a steady stream of bullets with constantly increasing depression, but this line of hits becomes very unsteady when the vessel rolls or pitches, and very ineffective when the object fired at moves, while my own ship follows the movement of the waves. Then it becomes necessary to fire volleys, because I have to aim ahead of the moving vessel to allow for the time of flight of the projectiles. I have to fire while my own ship rises just before it turns, and as I have to judge my distance and change my sight to an always varying range, it is the volley with the slight spreading caused by the vibration of the weapon which gives me the best chance of hitting.

I shall hardly be contradicted in saying that these are the most frequent conditions under which firing is done at sea.

This gun fires steel bullets weighing somewhat less than $\frac{1}{2}$ lb. each, with an initial velocity of about 1,400 feet, which gives a maximum penetration, at 200 yards, of $\frac{3}{4}$ -inch steel plate at right angles, $\frac{1}{2}$ -inch steel plate at 25° angle, and $\frac{3}{16}$ -inch steel plate at 20° angle, while it penetrates the side of a second class torpedo-boat at 10° angle, tearing up a hole many times larger than the bullet. It goes straight through a torpedo-boat (in and out again) at a distance of an English mile at right angles. It penetrates the side of a torpedo-boat and its boiler at 45° angle at 300 yards, and it penetrates the bow of a torpedo-boat,

four bulk-heads, and the boiler at 200 yards range, while its energy, after having passed through the bow of the boat and the bulkheads, is quite sufficient for breaking or otherwise spoiling any piston or connecting rod, cylinder, or fire-box which it may hit, or to pass out of the boat under the water-line on the opposite side if it does not hit the machinery before.

A projectile which does not actually penetrate the boiler, but which cuts a groove into it and glances off, is likely to cause an explosion, while the projectile which penetrates the boiler may not cause an explosion, but as it of course lets out the hot steam at great pressure into the boat, it not only stops the speed by degrees, but it makes it impossible to remain under deck, so that the torpedo-boat becomes unmanageable. In both cases the object is thus gained of stopping the boat, as does also a bent or damaged piston or connecting rod, or a hole in the cylinder, fire-box, or slide-box.

A solid bullet which retains its energy, after penetrating the skin, is thus much more effective for this purpose than a shell, the small fragments of which have very little energy left unless the shell is so large and breaks into so few pieces that each fragment has weight enough to do any considerable damage.

I do not think it probable that a torpedo-boat will attack except at night or in rain or mist, and before the gun can be got ready to fire at it, the torpedo-boat will probably be within 300 yards, a distance which it takes only half a minute to run. It is therefore of the very greatest importance that an anti-torpedo-boat gun should be able to fire extremely quickly at short range; and I do not think that the torpedo-boat can be stopped either by killing the stoker, who is in front of the boiler, or by letting in water through the skin of the boat: thus I think that solid projectiles will always be used in preference against torpedo-boats with a view to smash the machinery or pierce the boiler.

The British Government has signed an international convention, the practical result of which is to limit shells to a minimum calibre of $1\frac{1}{2}$ -inch, and Mr. Hotchkiss, whose gun was tried in Portsmouth, has adopted this calibre. His shells, however, are only about one-half of the proper weight for this calibre, and the initial velocity only about 1,300 feet. The penetrating power with over 1 lb. steel bullets is, therefore, only about the same as mine with less than $\frac{1}{2}$ lb. steel bullets, while the Hotchkiss common shell has even less penetration. At the final runs of the trials at sea at Spithead last month from 500 yards up to 100 yards distance from the torpedo-boat model, my gun scored 66 hits per minute against Hotchkiss 15 hits per minute. In the half minute which we would in reality probably have to fire, as above named, Hotchkiss's gun would have scored 7 hits, which, if solid steel shots, may perhaps have been enough to stop the boat; but my corresponding 33 hits in the same half minute would have done so more safely.

In several foreign reports the percentage of hits out of shots fired has been brought prominently forward; but I beg to warn against this as misleading, because the only important point is, *how many hits*

I can score with a weapon *in a given number of seconds*? The question of how many shots I have to fire in order to secure these hits has nothing at all to do with it, because we have so seldom a naval war, and torpedo attacks take place so seldom during a naval war that the cost of this kind of ammunition fired in action is infinitesimal compared to the cost of practice ammunition in time of peace.

My volley-firing guns are also useful in preventing an enemy from serving or letting off a Whitehead torpedo within its range, because no such torpedo could be sent off under my repeated volleys unless the torpedo were fired from under water.

Larger Machine Guns for Naval Service.

While I thus hold to my 1-inch volley-firing gun as the best weapon for defence against torpedo-boats, I am quite alive to the fact that, for general service on board, a shell-firing machine gun would be most effective against unarmoured vessels.

For this purpose the projectile should have the power of penetrating two $\frac{1}{2}$ -inch steel plates at an acute angle, so as to be able to burst the shell inside the bulwarks of any unarmoured ship afloat.

Our $1\frac{1}{2}$ -inch and $1\frac{3}{4}$ -inch guns will therefore fire $1\frac{1}{4}$ lbs. and $3\frac{1}{2}$ lbs. shells respectively, which, with an initial velocity of 1,700 to 1,800 feet (proportion of charge to projectile 1:3), will give per calibre nearly double the penetration of the same calibre of any revolving system with which I am acquainted.

In order to fire these with a rapidity of from 15 to 20 shots per minute (when aiming), I only require one barrel, which makes my gun only half the weight of revolving guns of the same calibre; but besides this gun, which is now ready, I also make volley-firing guns of $1\frac{1}{2}$ -inch calibre, which, with the same weight as the corresponding revolving gun, fires twice as rapidly. The greater weight of my shells for each given calibre gives me, besides the greater penetration, also the advantage that the shells, after penetration, break up into much heavier fragments, which better retain the energy for doing damage afterwards.

Conclusion.

And now, what is the outcome of all this so far as the British Army and Navy are concerned? It is hard to suppose that England will ever be engaged in offensive operations except as a diversion in favour of defence at some other point of her vast territory; and it is more especially for defence that these machine guns are most suitable—economising the lives of British soldiers and sailors, who are dear not only in a patriotic, but also in a pecuniary sense, and whose brains and energies are sufficient, if well armed, to hold their own even against the large odds of all comers.

It is true that the world is to a large extent for and not against England, but still there are clouds on the horizon which may call for active measures of defence over lines so vast that not a ship could be spared.

The defence of the Navy against torpedo-boats and the armament of the cruisers, which have to protect the commerce and communications with the Colonies, are most important subjects, considering the enormous commercial interests at stake—interests which cause much of the civilization of mankind to be bound up in the preservation and progress of the British Empire.

The cost of the maintenance of this defence and of constantly improved armaments, is the “insurance premium” paid by Great Britain for the security of her Empire—a very low premium, considering the value of the property—and I should feel very proud if I might flatter myself that I have contributed something which, even in the smallest degree, can have a decisive influence upon the strength of this defence, or, in other words, on the preservation of peace.

Major E. ROGERS, Staff Officer of Pensioners, F.R.G.S.: I must say that I am astonished that the question of the mitrailleuse has not yet been definitely settled. It takes my mind back to the year 1875, when I gave a lecture here upon the same subject. I thought then that some progress would have been made, but none seems to have been up to the present day. Then I go back to 1872, when we heard in this theatre a paper from our late lamented friend Colonel Fletcher, upon which occasion some most eminent men gave us the benefit of their experiences. A Committee had previously met and had gone thoroughly into the question, and it was then decided by them that the Gatling gun was the best system that had then been brought forward by the several inventors who competed. Now Mr. Nordenfelt has taken the field. I disclaim any intention to draw invidious comparisons between the Gatling gun and the Nordenfelt. This Institution is not for the purpose of entering into any detailed criticism of that nature. I look upon it rather as a sort of intermediate tribunal where the inventor comes and airs his theories, and tells us what he has to say, and where perhaps he is to some extent criticized; but eventually he has to be handed over to a Select Committee at Shoeburyness, and there the question between the Gatling gun and the Nordenfelt gun will be determined. The Gatling gun has never had a proper opportunity of being tried either in peace or in war. It was sent out during the Ashantee War, but it was mounted upon a narrow-gauge carriage, which was no doubt suitable to go through a woodland country, but it was top-heavy, upsets were frequent, and consequently the gun could not be taken to the front. It was left by Sir Garnet Wolseley to command the bridge-head at the Prah, and as you may remember it was fired into that river on one occasion for the edification and amusement of an Ashantee warrior, who, when he saw the effect of it, shook his head gravely, raised his hands to heaven, and went home and hanged himself! A few guns were also sent out to Natal. I volunteered to go out myself with a Gatling, but not with such guns as were employed there, which were of an obsolete pattern—the old pattern introduced in 1872. The guns that I wanted to go out with were of a far superior make and perfection of mechanism. I had some trials with them at Chester (indeed I drilled the Volunteer Artillery there to their use), and I was prepared to employ these guns practically against the enemy. The military authorities, however, did not consent to my proposal. At Ulundi the guns no doubt did execution. I regret that there do not appear to be any Artillery Officers present who could tell us what happened at Ulundi. I understand that a paper was read a few days ago on this subject at the Artillery Institution, Woolwich, but no one has come forward here to say what happened in the Zulu War with regard to the action of the Gatling gun. I believe the report of our friend Major Owen, R.A., has never been published. Were he in England, no doubt we would have learned ere this the actual facts. The gun has had, I contend, no chance of showing its powers in war. With regard to peace, the trials hitherto made, particularly at Shoeburyness, have been carried out with a bad cartridge. The trials made there the other day proved nothing but that the Boxer

cartridge is utterly worthless as ammunition for automatic firearms. The trials later on will, I hope, be conducted with a better class of ammunition. Mr. Nordenfelt has stated that he does not consider his system as competing with the artillery, because he thinks field guns are now so perfect. (Mr. NORDENFELT: I did not say that.) It was proved by the Committee in 1872 that the effects of the Gatling gun were equal to those of three field guns firing shrapnel; that is, the superiority of the Gatling in regard to the number of hits obtained was as three to one. There can be no doubt, therefore, that Gatling guns *are* able to compete with field guns as man-slaying weapons. No doubt the mitrailleur is incapable of doing any damage to *matériel* on shore: it can, in a word, do nothing that the best rifle with the best ammunition cannot do; but within that scope it is quite equal to any shell-firing gun, and it produces effects infinitely superior to case-fire, as was admitted by Artillery Officers in the discussion on the lecture given by me. With regard to the difficulty in the supply of ammunition, there is one suggestion I should like to take this opportunity of making. There was a paper read not long ago by Major Geddes of the 53rd Regiment upon "Manual Transport;" and it appears that the wheel proposed (which I would suggest should be used as part of the equipment of machine guns) is capable of carrying 2,000 rounds of ammunition as well as other supplies, in a country where there is no mule or horse transport. Sir, I have heard this remark from Colonel C. Brackenbury in this Institution, "We have the best mitrailleur extant, and the "only range finder; how is it that they have not been used in the autumn manoeuvres?" And I would ask, why have not Gatling or other machine guns been used in the autumn manoeuvres? I understand that the objection is that they do not fire blank ammunition; but there is no practical difficulty about that. If a Gatling gun were given to the troops at Aldershot, I am sure the General commanding could show what would be its use and status in war, by the tactical use of it in peace. The lecturer said something (which I should like to correct) about Gatling guns not being volley-firing guns. Neither is the Nordenfelt gun. Mr. Nordenfelt calls it a volley-firing gun, but it is simply a repeating gun; and when he wants to get accuracy he does not fire so quickly. The rapidity of the Gatling and the rapidity of the Nordenfelt are about equal. It is said that the Gatling system is only capable of a small-bore fire, and is therefore not a fit gun for torpedo service. There is no question, theoretically speaking (I speak under correction), but that a gun to repel torpedo boats must be a large calibre gun. It would seem from the lecturer's remarks that the Gatling is incapable of being constructed as a large-bore gun; but I have myself seen in the naval Service several 0.65 guns that could be used as torpedo-boat repellers if the ammunition were changed. As to this point, I may mention that many years ago I suggested to Dr. Gatling that he should employ with his guns steel-pointed bullets. I had myself a sporting Jacob rifle with zinc-capped bullets, and I remember smashing with one or two rounds of these pointed bullets a regulation target at 400 yards. When the question of repelling torpedo-boats arose during the Russian War, I repeated that suggestion, and asked Dr. Gatling to manufacture ammunition to pierce torpedo-boats. Mr. Nordenfelt then took it up. But I reiterate that there is no reason why the Gatling gun should not be adapted to torpedo service.

The CHAIRMAN: If there is any one here who has seen these guns used in actual service, we shall be glad to hear any remarks from him.

Commander CURTIS, R.N.: I do not see any guard to the Nordenfelt gun. It seems to me that one gun might be fighting a duel with another. I should like to know if there is any shield provided?

Admiral SELWYN: I should like to refer to a matter which gives me the greatest pleasure. Nearly ten years ago Mr. Daw obtained a prize for a thoroughly good cartridge, not quite so good for some purposes as the solid-drawn cartridge that came a little after it, but possessing very great advantages. Had we attended to our cartridges first, we should have been able to use machine guns with a perfect rifle, and we should have begun at the right end instead of at the wrong end of the whole question. Unfortunately, we committed a very great error. I said so at the time, and I am sorry I was not listened to. But that is not so necessary to refer to as the fact, that delay in such a matter is at this moment extremely dangerous. If we are to be left in the position of having a cartridge that we know is not a good one,

with which no machine gun can work successfully, until war breaks out, I think there is every probability that we shall find other nations ahead of us, and we shall regret too late not having done what we ought to have done. If I had any weight at all with the spending department, I should press on their consideration the fact that it is cheaper to do the right thing at once; that delay will only land them in a greater expense at last, and that there is really no reluctance on the part of the taxpayers to provide efficient weapons when they are asked to do so. Of course it is not necessary in this Institution to make comparisons between rival inventors of machine guns. We hope that each inventor will do his best. We are certain that he will get perfectly fair trials here, and we hope he may be able to bring forward his points so strongly as to convince not only the Committee, but his antagonists, which will be a more difficult matter. I may be permitted to define what is the true use of the different sorts of machine guns. It is quite clear that the small-bore mitrailleuse must come into play for all military purposes. If we are to have a machine of the greatest value against uncovered troops—not to compete with our artillery, which it never can do, because it cannot pierce stone walls or earthworks—against troops wherever they are seen *en masse*, or, in some cases, where they are not seen at all, as the Turks found out, for at a long range by covering the ground they killed more Russians than were killed in the assaults—if we are to have that kind of gun, we must be limited by the cartridge that we have for our rifle, whatever that may be. Now, I see here with the greatest pleasure a Martini-Henry solid-drawn cartridge, and I am told that some such cartridge is to be adopted. I only hope that some day soon we may arrive at some final decision as near perfection as that; then we shall have a cartridge for our machine gun and for our rifle, and there will be no mistake as to what ammunition is brought up. You remember what the Turks were able to do, firing in the air, with a very slight knowledge of where the supports of the Russians were, when they were advancing near Plevna, lying down, be it recollected, among the vine trees. The companies were reduced to mere skeletons. In too many instances the men did not get up when the Officer called to them, and he found that they had been shot through the back. If we recollect what the Turks did on that occasion, we may easily imagine what volley-firing from a mitrailleuse would do, aided by a balloon to indicate the direction and the distance. The gun may be of very great use in that way and in ways that are not at present thought of at all, but it certainly cannot come into use where shell guns ought to be brought to the front. In regard to the naval use of machine guns, we have to deal with a totally different condition of things. In the ship there is no difficulty in carrying any number of different sorts of ammunition, and they will all be brought up to their separate guns with the utmost certainty and rapidity. It is not like a transport train, which may have to go up through smoke, and may not get at the right place. We have never any difficulty, when we have five or six guns of different calibre, in getting ammunition for each of them. It is clear that for a torpedo attack nothing short of a gun that will pierce the shell of the boat, and if possible the boiler, will be of any value whatever. The boiler question is a very serious one; and if we are to consider the torpedo-boat as she at present exists, with the boiler taking up the larger position of her mid-ship both laterally and longitudinally, the extreme liability of its being pierced, and the fatal results of any escape of steam, as Mr. Nordenfelt has said, below deck, and the impossibility of any other than a fatal result to the attack, I think we shall see that machine guns of large calibre are very well worth carrying for that purpose alone. I should separate those entirely from those which are valuable for disembarkation, or for protecting the landing of boats, or resisting a mere ordinary boat attack. There is certainly a tendency in modern days, both in the Army and the Navy, to economize our men. I do not believe that to any large extent guns like these can be left on the deck of an ironclad exposed to a distant fire. There would be very little left on an ironclad, certainly not the boats, or any of those beautiful arrangements which we see hung outside the turrets protected by a thin iron plate, if protected at all. I do not think anything could be left there; I do not see why you should leave them there during an attack. I think they ought to be so protected and kept as that they can be put into place at the moment when they are required during a naval attack, always excepting the case of a torpedo attack at night or

during mist in the day. The one question that we want to have solved immediately, and which I hope this meeting will advocate being done with all the energy that can be put into it, is the question of the cartridge, in order that both rifles and machine guns may be properly constructed for a proper cartridge, whatever may be the calibre decided on for each purpose.

Major L'AMY: A question has been asked as to what the Gatling guns did at Ulundi. I was not there myself, but I had information from one Staff Officer who was present, and from another who had to report on what was done, and their statement was that two Gatling guns were placed upon the flanks of the square at Ulundi, and no sooner were they brought into action than they jammed, and were utterly useless during the rest of the day.

Major ROGERS: I hope this meeting will not carry away a wrong impression. It was stated in the paper read the other night at Woolwich that 3,000 rounds were fired, and that the guns killed a great many Zulus. But the fact was, the Gatling was of an obsolete pattern. Two guns were sent out from England in the transport that was wrecked, and these were replaced by two sent from the Mauritius, guns that had been there since 1872 I suppose. But the question is whether the men who used the guns understood them.

Mr. NORDENFELT: Is there more than one pattern in the Service?

Major ROGERS: Yes, there are two calibres.

Mr. NORDENFELT: There is only one pattern.

Major ROGERS: They were never previously issued to the troops; they were fired for the Artillery in 1871; the pattern is now an obsolete one, and they were not such guns as you will have to compete with.

Mr. NORDENFELT: I need not make many remarks by way of reply. Major Rogers has made some statements about the Gatling gun which I am pleased to hear, because what the Gatling gun does well my gun does better still. We have fired blank ammunition, and I have offered to the authorities to send out one of my guns with blank ammunition. The difference between my gun and the Gatling gun as to volley firing is very easily defined: we do fire volleys, and the Gatling gun does not. The Gatling of large calibre in the Navy is 0.65; but I hear that Dr. Gatling is now busy constructing a 1½-inch gun. I shall be glad to know its weight per calibre. I have been asked whether there is a shield to my guns. There is not, but the Admiralty authorities are going to put a shield round them, not above, but below and round the centre, so as to protect the men, their faces only being seen. As the gallant Admiral has already said, I do not suppose the guns will be on deck in a general fight, except for special purposes and anti-torpedo purposes. With regard to the Boxer cartridge, I admit that it has great faults; but both the gallant Admiral and Major Rogers forgot to notice that my guns did fire over 10,000 Boxer cartridges at Shoeburyness with tremendous rapidity, and there were only two that did not act properly. Dr. Gatling did not succeed in firing his thousand shots consecutively at all. I admit that he will probably do better with a solid cartridge. I cannot speak too highly of the fairness of trials in England. Everything was done, both at Portsmouth and at Shoeburyness, in the most marvellously straightforward manner. Crews have been trained for both guns, and everything has been done in the fairest way. I think all the competing inventors will agree that they have been treated most kindly and fairly. The gallant Admiral spoke about hitting the Turks. Well, that means hitting with fair accuracy; but hitting with accuracy at Shoeburyness is a question of inches and fractions of inches. When you have decimals of inches at 300 yards that is a very different thing from ordinary firing. I should be very pleased if the Admiralty would some time or other fire against a boiler with 120 lbs. pressure inside, to see the effect of a shot against a torpedo-boat boiler in action. I will now show the action of these guns.

The CHAIRMAN: In all these discussions it is, of course, impossible to prevent a certain amount of rivalry between two different systems. I am sorry there is no Officer present who was with the Naval Brigade under Colonel Pearson before they marched to Ekowe. I was told that two Gatling guns did great execution on that occasion.

Major ROGERS: I think they were naval guns.

The CHAIRMAN: I was told that the guns were very serviceable.

Major ROGERS: There was a complaint in the dispatch that the men did not understand the gun, that they upset it and damaged the action.

The CHAIRMAN: With regard to the Nordenfelt system, I understand it is going to have a thorough trial, and as Mr. Nordenfelt acknowledges that the trial will be a fair one, we must await with great interest and anxiety the result of the competition.¹ Of course these discussions are so far beneficial that they ventilate the subject, but the real test is, first the trial in time of peace, and, above all, the trial on active service. The defects of the guns then become apparent, and are afterwards corrected. I have only now to ask you to give your cordial thanks to Mr. Nordenfelt for bringing these matters before us.

¹ Appendices B, C, and D have been supplied by Mr. Nordenfelt since the reading of his paper.—ED.