Percussion Torpedo.—The percussion torpedo is a floating box of wood or iron moored below the surface of the water, and fitted with percussion fuses which explode on a ship's striking it. This kind has the advantage of cheapness, but they are only adapted for the defence of a harbour already blockaded, and whose trade is entirely interrupted, for they are just as dangerous to friends as to foes. We may therefore dismiss them as quite unsuited to the object that we have now in view.

Shore-fired Electric Torpedo.—In the shore-fired electric torpedo, the charge is ignited by an electric fuse connected by means of a submarine insulated wire with a galvanic battery placed on shore. This kind has the advantage of being quite safe for friendly vessels, as they explode only at the wish of the operator on shore, and they also present the chance of an enemy's vessel passing through without exploding any of them. They have, however, the great disadvantage of not securing the harbour against a sudden surprise by night; and the quantity of insulated wire necessary for each torpedo would be a serious item in the expense.

Self-acting Electric Torpedo.—In the self-acting electric torpedo, the wire from the shore is attached to one of the poles of the fuse, while the other is connected with an insulated metallic plate near the top of the torpedo. Through the top a pivot projects, to which are attached several arms; on these arms being struck by any passing body they swing round with the pivot, and bring the lower part of it into contact with the metallic plate, and thus complete the circuit. These have therefore all the advantage of security against surprise possessed by the percussion torpedoes, while they are quite as safe for friendly vessels as the shore-fired torpedoes, for until the operator on shore connects the insulated wire with the battery they are perfectly harmless. They will no doubt be more expensive than the shore-fired torpedo.

Harvey Torpedo.—The torpedo invented some years ago by Captain Harvey, R.N., is on quite a different principle. It consists of a strong timber case bound with iron, and is rectangular in section and rhomboidal in plan. It is brought into contact with an enemy's vessel by means of a tow-line paid out from a fast ship. The shape of the torpedo makes it, when towed, diverge at an angle of nearly 45° from the path of the ship towing it, and on striking it explodes by means of percussion fuses. In a series of trials made with an unloaded torpedo of this description against the turret ship "Royal Sovereign," it was found that she was struck by the torpedo every time, and that she only succeeded in firing from two to twelve shots at the attacking ship before she was struck. The advantages of these torpedoes are their cheapness, and that they can be used just when and where they are wanted.

Charge.—Gun-cotton.—With regard to the charge, it appears that Abel's compressed gun-cotton is considered in England to be superior to gunpowder. This substance, when damped with a weak solution of carbonate of soda, can be sent without risk to any part of the world, and may then be easily dried at a temperature of 180° F. (the temperature of explosion being 300° F). It must, however, be remarked that gun-cotton is very *hygroscopic*, and this defect would make its use uncertain in a moist climate like that of New Zealand. If, however, the torpedoes were charged with freshly dried cotton, and then kept under water, they would probably remain in good condition for some time; but if kept for long in the air their action could not, I think, be depended on. Even the india-rubber coating to Prentice and Co.'s gun-cotton cartridges is not able to keep out the moist air of this climate. The manufacture of gun-cotton requires so much care that, unless it can be obtained through the Home Government, I should much prefer using gunpowder.

Difficulties in Details.—There are also several difficulties in the details of torpedo defence, such as the rise and fall of the tide, the chance of a friendly ship touching the arms of a self-acting torpedo and leaving it in such a position that the pivot touched the insulated plate, in which case a premature explosion would take place immediately the wire was connected with the battery. These will no doubt be found fully discussed in the Reports of the Torpedo Commission in England, and of the subsequent Committee of which Colonel Nugent, C.E., was President.

Distance between Torpedoes.—The distance apart at which self-acting torpedoes should be placed will depend, not on their size, but on the chances of a ship passing through without striking any of them. At 25 yards distance, a ship of 40 feet beam would be certain to touch one; while at 55 yards apart, the chances of her striking or passing through safely would be equal. We may therefore conclude that seventy torpedoes would be required for a line one mile long. Torpedoes fired from the shore might, if they were large enough, be placed further apart.

Defence by Guns.—The great advantage which guns placed in shore batteries have over those on board ship has been proved over and over again; even in smooth-bore days, small one-gun batteries have performed almost incredible feats. Thus, at Antwerp, in 1814, a 5½-inch howitzer drove off a French 84-gun ship, with a loss to her of forty-one men; and at Cape Licosa, south of Naples, a one-gun battery *protected from assault*, and defended by twenty-five French soldiers, successfully resisted an attack by an 80-gun ship and two frigates under Sir Sidney Smith, and it was only compelled to surrender by landing in boats and surrounding it. The reason of this is, that although a ship can work her guns quicker than a shore battery, the unsteadiness of the deck prevents a good aim being taken. The accuracy of ship guns depends entirely on the distance, and at anything over 1,000 yards the shore gun has a very great advantage. It will therefore be seen that rifled guns and elongated projectiles, by increasing both the accuracy and range of guns, has given an enormous advantage to the shore battery, so much so, that I feel confident that two powerful rifled guns could with ease destroy a whole fleet of wooden ships, no matter how they were armed, if they could only keep them at a sufficient distance. In the present day, therefore, no guns can be admitted for the defence of forts against ships but those that are rifled, for with smooth bores the whole of the advantage of stability of platform would be thrown away. Probably the best gun that we could have for the defence of our harbours would be a 7-inch built-up gun weighing about 6½ tons and throwing a solid shot weighing 114 lbs. or 120 lbs. This gun, with an elevation of 19½° and a charge of 22 lbs. of powder, would range about 4¼ miles. As however it is very unlikely that the Home Government could spare any of these guns for some time, I should recommend that the gun to be used for the defence of the harbours of New Zealand be the old 68-pounder smooth bore, bored out and fitted with an internal rifled tube of steel or coiled iron, reducing the calibre to 7 inches. These guns are, I believe, equal in accuracy and range to the built-up