Scientific American.

MUNN & CO., Editors and Proprietors.
PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

Onecopy, one year, postage included.......................$3 20
One copy, six months, postage included.......................1 60

Club Rates:

Ten copies, one year, each $2 70, postage included.......................$27 00
Over ten copies, same rate each, postage included.......................2 70

☞ By the new law, postage is payable in advance by the publishers, and the subscriber then receives the paper free of charge.

NOTE.—Persons subscribing wi please to give their full names, and Post Office and State address, plainly written, and also state at which time they wish their subscriptions to commence, otherwise they will be entered from January 1st, 187.. In case of changing residence state former address, as well as give the new one. No changes can be made unless the former address is given.

VOLUME XXXII., No. 4. [NEW SERIES.] *Thirtieth Year.*

NEW YORK, SATURDAY, JANUARY 30, 1875.

Contents.

(Illustrated articles are marked with an asterisk.)

ELECTRIC EARTH BATTERIES.

In the year 1838, Steinheil made, on the railroad from Nürnberg to Fürther, an experiment in using the rails as conductors for telegraph despatches; but he found that the current passed through the earth from one rail to the other, and then he conceived the idea of using the earth for the return current, thus saving half the wire. He found that it not only worked perfectly, but better than a wire for the return current, as the earth and one wire gave only half the resistance given by two wires, which were used before this great discovery, which was of the utmost practical importance to the progress of the telegraphic art. The manner in which this method of using the earth for the return current is applied is to bury, at each of the two terminal stations of the line, a copperplate in the moist earth, and connect it by means of a wire to the telegraph apparatus or battery. Gauss, in repeating this experiment, conceived the idea of leaving the battery out altogether, and burying at one station a large copper plate and at the other a large zinc plate; and he found that a powerful electric current then passed through the wire. This arrangement is evidently nothing but a single voltaic pair, constructed on a large scale, as the layer of moist earth of a few miles in thickness between the metallic plates replaced the layer of acidulated cloth, paper, or liquid in the cell.

Bain applied this arrangement to his telegraph, so as to obtain a current of long duration and constant quality. He buried a series of zinc and copper plates, opposite to one another in the moist earth, and connected them by insulated wire; and so obtained a current of sufficient strength to work his telegraph. According to the same principle, a variety of voltaic batteries or generators of electricity have been constructed, by means of which Bain, as well as Robert Weare, kept his electric clocks in constant and very regular motion. Such an earth battery remains in similar activity until in the course of time one of the metals has become entirely oxidized, which oxidation, according to experience, takes place only very slowly when large plates are buried deep in the moist ground.

The most extensive application of such batteries was made by Steinheil on the railroad from Munich to Nanhofen; the line was 22 miles long, and the earth battery was completely successful in performing not only the service required on the road itself, but also in serving for the sending of despatches for the public. The metal plate in Munich was of copper, of 120 square feet, while in Nanhofen a zinc plate of the same size was buried; both plates were sunk so deep as to reach the level of the subterranean well water of the locality, and connected with isolated wires to the air line. The current thus established was used to effect the deviation of a magnetized needle in a galvanometer, which Steinheil used as the basis of his system of signals, a system requiring only a very feeble electromotive force, a force entirely insufficient to move the electromagnets of the Morse system, or the hand of a dial telegraph.

The construction of such earth batteries, easy and simple as it appears to be, has never become a settled practice, for reason of the laborious digging required, it being much easier to plunge plates in cups and renew them after a while than to dig up the oxidized zinc plates in order to replace them by new ones. However, when a river or brook is at hand, the practice can be recommended; as in that case a zinc plate has only to be sunk at a convenient and safe spot. Then at any time, if the current becomes weak, the plate may be easily replaced by a fresh one; while in place of the copper, a quantity of coke may be buried in the moist earth. The great objection to this form of battery is, however, the unavoidable total lack of intensity: as the latter quality depends on the number of cups, and the earth or water acts as but one single cup, and thus the burial of several plates is equivalent only to the immersion of them in a single cup. If the plates are connected for quantity, that is, all the zincs together and all the coppers or cokes together, the series will act like a single pair of which the surface is equal to the sum of the individual plates, and thus as one pair of large surface: if, however, the plates are connected for intensity, that is, every alternate zinc to the next copper, only the two plates at the extremes of the series will be of use, because the several intermediate pairs discharge mutually all the electricity generated into the moist earth, through their metallic connections: which shows the fallacy of the advantage claimed for some earth batteries lately constructed and even patented.

Of all the batteries thus far constructed, the most constant appears to be that of Leclanché; it is to a certain extent an imitation of an earth battery. It consists of a large piece of coke surrounded by coarsely pulverized manganese and coke, all contained in a porous cell and surrounded by amalgamated zinc plunged in a solution of sal ammoniac. This battery has, during the last ten years, been more and more used in France; and according to the testimonies of the telegraph operators there, it far surpasses all others, for reliability and constancy.

TORPEDOES FOR HARBOR DEFENSE.

Approaching New York from the sea or the Sound, one can scarcely fail to observe, printed in very large letters on the faces of the forts which command the passage, the warning words: "TORPEDOES: DON'T ANCHOR."

We have heard the significance of the warning, frequently discussed by fellow passengers this summer, with a growing conviction that few implements of modern warfare are so little understood by peaceable people as the torpedo. "There's a lot of them stored in the fort, I suppose" (said one passenger to another the other day, in response to the question, "why not anchor?"), "and of course it wouldn't be safe for a vessel to lie alongside."

That torpedoes are submarine engines, designed to blow up invading vessels, is more commonly understood; but how they are made and placed, how exploded, and why vessels should not anchor in their vicinity, fewer seem to know.

It is natural that this should be the case. As an efficient weapon of defense, the torpedo is comparatively a new affair; indeed, it may almost be said that it is altogether an experimental affair; and though it is confidently predicted that, when the next great struggle between maritime nations comes off, it will be found that a revolution has been wrought by the torpedo in methods of conducting naval warfare, only the few who are actively engaged in developing this future decider of battles know very much about its character or capacity. This, too, is natural. The torpedo, like a mine or a masked battery, is valuable in proportion to the enemy's ignorance; and it would be simply foolishness on the part of any government to develop a torpedo system at great expense, then nullify their work and its advantages by spreading too minute a knowledge of it. Still, a general idea of torpedo operations can be gained from facts which are common property, without reference to any particular system of harbor defense; and a general idea is quite as much as the most of us care for in cases of this sort.

Distributed in a narrow passage, torpedoes are intended to arrest the progress of an enemy's vessels, either by compelling them to pause through fear of unseen danger—thus keeping them longer under fire of powerful land defenses—or by destroying them by direct explosion should they venture within the torpedo-defended area. In construction, the torpedo consists of a strong metallic case filled with gunpowder or other explosive substance, and fitted with an apparatus by which it may be fired, either mechanically by the shock of a colliding vessel or by the action of some one on shore. The first, or automatic exploder, is the simplest in construction and action, but has the great disadvantage that it cannot distinguish friend from foe. A passage defended by self acting mechanical torpedoes is therefore closed to all vessels, and their use must necessarily be confined to special positions and occasions. It is perhaps needless to observe that such a system of defense would not answer in channels thronged with peaceful shipping, like those which lead into our harbor. In cases of this sort, the thing needed is obviously something that will lie safely on the bottom or securely moored below the reach of passing vessels, completely under control by some one on land, and with no risk of untimely explosion.

The earliest torpedoes to be operated from the shore were arranged to be fired by a friction tube attached to a cord communicating with the land: a plan partially successful where the channel was narrow and the period of the firing line's exposure comparatively brief, but quite unsuited for permanent defenses and long ranges. During the Crimean war, the Russians first employed electricity as a means of exploding torpedoes, and the same method was adopted in some instances in the South during our "late unpleasantness." Since then the electrical system, both automatic and volitional, has been developed by numerous experiments in various countries, a very interesting series of them being just now in progress at Portsmouth, England, in connection with an experimental ironclad called the Oberon, the design being not merely to ascertain the destructive effect of torpedo explosions, but various other important questions touching the working of torpedoes arranged on what is known as the network system. By this plan any number of torpedoes may be placed in electrical communication with a firing station on land, so that the condition of each and all can be determined at a glance and any one of them exploded at will, without affecting the others. The connecting cable contains strands of copper wire insulated by gutta percha and covered by a protecting envelope of hemp and coiled iron wire. The copper wires lead from a galvanic battery on shore to the signalling and firing arrangements within the torpedoes, the one indicating to the operator the presence of a vessel within the destructive area of a torpedo, the other enabling him to explode the sunken mine by touching a key. In other cases the firing circuit is so arranged that it can be closed mechanically by the action of the signalling apparatus, thus making the torpedo automatic. The firing is effected by an electric fuse, commonly that known as the platinum wire fuse, in which a strand of platinum wire is made red hot by the electric current on the completion of the circuit. It is evident, as a writer in the London *Times* observes, in justification of the expensive experiments going on at Portsmouth, that a complete system of torpedo defense, embracing more complicated details, cannot be brought to perfection without extensive and exhaustive trials. "There are a multitude of problems connected with the subject which can only be solved by experiment. The action of the circuit closers may or may not be influenced by the rate of the tide in particular positions; the presence of sharp rocks may render electrical torpedoes impossible; the laying and raising of the cables and other parts require constant practice under various conditions to insure efficiency; lastly, it is absolutely necessary to know the range or distance at which a given torpedo ceases to be effective when exploded. This latter question is the more important, because upon its solution may depend, in a great measure, the quantity of the explosive agent to be used, and the relative positions of a group of torpedoes. The disruption of a number of other submarine mines by the explosion of a torpedo in their vicinity would seriously affect the defensive arrangements, and would probably lead to a complete gap in the line. It is therefore advisable that the amount of the explosive agent in a torpedo should be regulated so as to insure the maximum destructive effect upon a hostile vessel with the minimum disruptive effect upon the adjacent torpedoes."

The experiments carried out on the Oberon are said to show that comparatively large charges cannot be exploded without compromising other mines within the effective area. It remains to be decided which is best: to use large torpedoes far apart, and thus diminish the area of danger to hostile ships, or to use a smaller charge and moor the torpedo so that its explosion will occur in contact with or as near as possible to the vessel to be destroyed.

It is scarcely necessary to recur to the warning: "Don't Anchor." What the arrangement of torpedoes may be in the forbidden areas, it is not needful to know; a dragging anchor would be likely to disturb the nice arrangement of electric communication, and might possibly prove disastrous to private as well as government property.

SOMETHING ABOUT BALLOONS.

A reference to our files will show that we have endeavored to keep our readers fully informed in regard to the progress of aerial motors; for although the final success of the problem is far from being assured, the earnest labors of scientists augur well for the future. We have received so many inquiries, of late, in regard to the elementary principles to be observed in designing balloons, that it seems advisable to devote some little space to their consideration. Information of the kind sought for, simple as it may seem, can scarcely be found in any of the published literature of the subject; and the general solution of the question given in this article appears now for the first time in print, so far as our knowledge extends.

The general formula for the proportions of a balloon is somewhat intricate, and we have endeavored to simplify it so that it can be applied by any one who understands arithmetical operations.

The first point to be considered is what makes a balloon rise. We receive numerous questions such as the following: "What is the lifting force of a cubic foot of hydrogen, in pounds?" from which we infer that a few words on this subject may not be out of place. The hydrogen, or any other gas, however light it may be, has no lifting force