a firmer and more extended base of concrete under the footings of the wall.

He thought that the method of forming the piers was as good and as cheap as any known mode that could have been adopted; but if he had to build another bridge of the same dimensions, and under similar circumstances, he would not use cast-iron, but would construct it of timber, not on account of any engineering difficulty, but simply because a timber structure would be very much cheaper, and equally serviceable for the purposes of the railway, taking into account comparative durability as well as present cost.

ON THE PROGRESS MADE IN THE APPLICATION OF ELECTRICITY AS A MOTIVE-POWER.

W. R. Grove, Esq., submitted a communication to the Royal Institution, on the 9th ult., the subjects of which were—1, a brief summary of the laws of the electro-magnetic force; 2, a description of the chief modifications of the engines to which that force has hitherto been applied; 3, the commercial statistics of its application; 4, the purposes for which this power is available. In dealing with the first of these subjects, Mr. Grove exhibited, by many illustrative and successful experiments, the well-known re-actions of iron and other metals on each other, when exposed to the influence of an electric current. The actual application of these familiar phenomena was then shewn in the working models of several machines, which were set in action by the nitric acid (or Grove's) battery, invented by Mr. Grove, and described by him four years ago at the Royal Institution. These machines may be divided into three classes; first, those acting by the immediate deflecting force, as shewn in the galvanometer, Barlow's wheel, &c.; secondly, those on what is called the suspension principle. In these, two powerful electro-magnets are fixed contiguous to the periphery of a wheel, and in the line of its diameter, plates of soft iron being fastened on this periphery at short and equal intervals. The electro-magnets are so arranged as to lose their attractive power as soon as they have drawn through a given space each plate of iron, necessarily presented to them by the revolution of the wheel, but are immediately afterwards re-invested with this power, in order to operate on the next plate. By these means the wheel is kept in constant rotation on its axis. The remaining class of electrically-driven machines are applications of the principle of Ritchie's revolving magnet. In these, an electro-magnet, balanced on a pivot, so as to rotate in a horizontal plane, is arranged between the poles of a permanent magnet. Hence, the alternate attractions of the opposite magnetic poles, combined with its own momentum, cause the electro-magnet to continue rapidly revolving. Having noticed machines, on these various principles, by H. Fox Talbot, Esq., Mr. Hill, of Swansea, and Professor Wheatstone, Mr. Grove proceeded to his third subject—the commercial statistics of electro-magnetic power. It appears, by the experiments of Dr. Botto, that the consumption of 45 lbs. of zinc will produce an effect equivalent to a single horse power for twenty-four hours. The cost of the metal, at 3d. the pound, would amount to 11s. 3d. About 50¼ lbs. of the nitric acid of commerce would be required to dissolve the metal in the most economical and effective manner. The charge of this, at 6d. the pound, would be 1*l*. 5s. 6d. The whole expense, therefore, of obtaining the effect of a 1-horse power by an electro-motive apparatus, would be 1*l*. 16s. 9d. In this calculation the cost of the requisite sulphuric acid is assumed to be fully covered by the value of the salts of zinc produced in the operation. The same amount of power produced by a steam-engine would not cost more than a few shillings. Mr. Grove explained that this comparative costliness of the electro-magnetic machines resulted from the sources of their force, zinc and acid being manufactured, and, consequently, costly articles; whereas, coal and water, the elements of the steam-engine's force, were raw materials, supplied at once from the earth. Mr. Grove took this occasion to observe, that the experiments of Botto, just alluded to, were made with his (Grove's) battery; and that upon the cost of the constituents of this, the calculations were founded. At first sight, this battery would appear a dear form, from the expense of the nitric acid; but a little consideration proves the contrary of this. Compare it, for example, with a battery merely charged with dilute sulphuric acid (the cheapest possible electrolyte), to perform an equivalent of work (as the decomposition of a given quantity of water), a series of three cells of the ordinary battery is necessary; hence the consumption of three equivalents of zinc, and three of sulphuric acid. But the intensity of the Grove's battery is such, that the same resistance can be overcome by one cell, consuming only one equivalent of zinc, one of sulphuric acid, and one-third of nitric (there being in this acid three available equivalents of oxygen). Independently of this smaller consumption, Grove's battery has the advantage of occupying only one-sixteenth of the space of the other constructions. In concluding his communication, Mr. Grove mentioned the two well-known applications of electric power—the electric telegraph and the electric clock. To neither of these can steam, or, indeed, any known force, be so applicable as that which travels with a greater velocity than light itself.

ON THE LIGHT THROWN ON GEOLOGY BY SUBMARINE RESEARCHES.

The following interesting lecture was delivered by Professor Forbes at the meeting of the Royal Institution on the 23rd February:—

Having alluded to the researches of two Italian naturalists, Donati and Soldani, who dredged the Adriatic about the middle of the last century, Prof. Forbes entered on the important inferences which he had derived from similar investigations in the Irish Channel, and in the Archipelago. His first conclusion was, that marine animals and plants are grouped, according to their species, at particular depths in the sea, each species having a range of depth appropriated to itself. Prof. Forbes illustrated this assertion by a diagram, indicating the plants and animals respectively inhabiting what he termed the *littoral* zone, which extends immediately from the coast—the *laminarian* zone, where the broad-leaved fuci are most abundant—the *coralline*, in which there is an assemblage of mollusca, especially bivalves and corals, and the *deep sea coral*, so called because in it only we find examples of large corals on the British shores. Prof. Forbes next alluded to the fact of the number of species diminishing according to depth, so that by gaining an accurate knowledge of the Fauna and Flora, appropriated to various sea-bottoms, the naturalist can infer their depth—no plants are found below 100 fathoms, and the probable zero of animal life is at 300 fathoms. Sedimentary deposits below this depth are consequently destitute of organic matter. This circumstance bids the geologist to be cautious in inferring that any stratum was formed before the creation of animals, on no other account than that it is devoid of organic remains: he should rather conclude from such deficiency, that the stratum was deposited in very deep water.—Prof. Forbes next remarked that British species are found throughout the zones of depth in the Mediterranean Sea; but that in that sea, the proportion of northern testacea in the lower zones greatly exceeds that in the upper, so that there is a representation of climates, or parallels of latitude, in depth. The fourth proposition advanced by the Professor, was, that all varieties of sea-bottom are not equally capable of maintaining animal life. The sandy parts are usually the desert ones. Hence the scarcity of fossils in sand-stone: though traces of worms (which inhabit the sand) are found in ancient sand-stones. As each animal is not able to live, except on its own locality, those marine animals, as the scallop, which are gregarious, deteriorating the ground when they increase beyond a certain extent, die; then the place becomes silted up, the ground changes, and another race occupies it. This fact explains the phenomena of distribution of organic remains in rocks,—*i. e.* their being grouped together in separate strata, fossilliferous strata alternating with those which are free from organic remains.—Prof. Forbes proceeded to observe, that such animals as are common to many zones of depth, are those which have the greatest horizontal range in space, and are generally those which are present in the tertiary deposits; and thus it is that the most generally distributed fossils are such as are found in the greatest number of formations; because these are necessarily the most independent of destroying influences. But, on the other hand, as the elevation or depression of strata to a very small extent would destroy the species peculiar to any zone, or to the zone above or beneath it, it becomes an important inquiry how this destruction is compensated. In dealing with this question, Prof. Forbes announced a most important law in zoology, one altogether new to ourselves—viz. *That the mollusca migrate.* He discovered by his own observation, that this is the case even with the limpets, the most fixed of all species. This migration occurs in their egg-state, when the ova are strung together, and floated over the ocean, from shore to shore. In the larva state they are swimmers. In fact, they commence their life in a form closely analogous to that which is permanent among the pteropods. But, though in this state they can live in any zone, they cannot arrive at perfection except in the peculiar zone to which they are adapted. This accounts for the very imperfect shells of prematurely dying mollusca being found at a low depth. Professor Forbes concluded his communication by noticing its bearings on the views of the most eminent geologists of our time. 1st. With regard to Mr. Lyell's principle of distinguishing tertiary strata by the per-centage of recent species in each. This is confirmed by Prof. Forbes's investigations; only in using Mr. Lyell's criterion, the element of depth, which gives climatal character in living animals, must be taken into account. 2nd. Prof. Forbes next noticed that Sir H. De la Beche had hypothetically anticipated, what his researches established, the representations of climates and depth, ten years ago. 3rd. He lastly ascribed to Viscount d'Archiac and M. de Verneuil, the credit of having announced (what he had observed and mentioned in the course of his communication) that species which are found in a great number of localities, and in very distant countries, are always those which have lived during the formation of several successive systems.

ARTESIAN FOUNTAINS.

The announcement of an intention to sink an artesian well in the neighbourhood of Trafalgar-square has frightened many wise heads into the supposition that such an operation would dry up the neighbouring ordinary wells. This arises from the distinction between an ordinary well and an artesian fountain (as it ought properly to be called) being apparently either unknown or not understood. Such fountains derive their name from having been first bored for in the province of Artois, in France; and the conditions essential to constitute such a fountain are, that the waters shall be forced up to the surface by the pressure from beneath, which is not the case in ordinary wells, from which the waters are pumped up, or drawn up by buckets, &c.

Tertiary basins (geologically speaking), such as London and Paris are situated in, are considered the most favourable for piercing for artesian fountains; and to reach such, it is not only necessary to go below the bed of water which supplies the ordinary wells, but also that, by means of a tube or other conveyance, the superficial beds of water should not mingle with those which are brought up from below to the surface. The means taken to effect this would require a lengthened description: the accidents to which even metal tubes are liable, from being subjected to the enormous pressure sometimes met with, were well illustrated in the case of the celebrated artesian fountain of Paris. The principle upon which artesian fountains are pierced for is the stratified deposition of the beds and the alternation of permeable and impermeable strata in any given place. The ordinary wells of London are all derived from above the London clay; the alluvium covering the surface of which is full of water, from the impermeable nature of the sub-stratum of clay. The quantity of water is so great, that many large distilleries, sugar-houses, and some of the breweries, are supplied with this water. The water of the London clay itself is impure, and contains salts. Such are the saline springs of Bagnigge Wells, St.

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