the platforms for pedestrians and bicycle traffic, an iron hand-rail serving to separate the two. As compared with the Brooklyn Bridge, it will be seen that the convenience of the public, as regards the latter form of travel, has been consulted by providing separate roadways for east and west bound traffic.

The stringing of the main cables will be carried on from two temporary footbridges. These footbridges will each be carried upon two cables, each cable consisting of three 2¼-inch cables. On April 9 the first of these cables was carried across the river, the method adopted being different from that followed in the case of the Brooklyn Bridge. The ends of the cables were first carried up over temporary saddles on the top of the New York tower and drawn down to the New York anchorage, where they were made fast. The drums containing the rest of the cable, say about 1,900 feet, were placed abreast upon a large scow which was towed sideways across the East River to the base of the Brooklyn tower. During the passage all river traffic was stopped, and the cables were allowed to sink until they rested upon the bottom of the river. The next step was to hoist the Brooklyn ends of the cables over the tower, carry them down to the anchorage and draw them taut until the desired curve had been obtained.

In conclusion, it may be well to recapitulate some of the leading dimensions of the bridge. Its entire length between terminals is 7,200 feet; length of main span, center to center of the towers, will be 1,600 feet; the foundations of the towers are timber and concrete caissons sunk to bed-rock. On these are masonry piers which are carried up to 23 feet above high water. The steel towers extend 335 feet above the river and 442 feet above the lowest foundation. The anchorages for resisting the pull of the cables measure 182 feet in width, 158 feet in depth and 120 feet from the foundations to the coping. Forty feet of the mass will be below the street level, above which it will extend some 80 feet. Each anchorage contains 44,597 cubic yards of masonry, and its total weight is 125,000 tons. The total pull of the four cables upon each anchorage is 20,250 tons.

Automobile News.

A very handsome automobile has been made for King Leopold II., of Belgium, by Panhard & Levassor, of Paris. The carriage-work of this machine is of the most elegant design and construction. The body, of aluminium, is finished in red, with the truck in blue. The wheels are of blue, relieved with red. All the wood parts which are visible are of polished mahogany. The seats are of a new design and very comfortable; they are covered with red morocco. The motor, of the petroleum type, is rated normally at 20 horse power, but will give as high as 30 at full capacity. It has four speeds, 12, 24, 36 and 48 miles an hour and a back movement, all controlled by a lever. The ignition is by spark, with Basée & Michel induction coils. The machine has been lately delivered to King Leopold at Nice.

An interesting experiment with an automobile upon a snow-covered route has been lately made in France. The Baron Xavier Reille, Deputy of Tarn and the Mayor of Lacanne-les-Bains, in an 11-horse power machine, made a trip of 32 miles in 2 hours and 35 minutes over a hilly road covered with 10 inches of snow, which proved impracticable for ordinary vehicles. This road leaves from Castres, at 600 feet altitude, and then mounts to 1,200 feet, ending at Lacanne-les-Bains at 2,700 feet altitude. As the old system of diligences had considerable difficulty over this road, especially in winter, it was desired to replace these by automobiles, and the present trip was made with this end in view. The experiment has proved conclusive, and this spring a line of automobile vehicles will travel over the route.

M. Serpollet, the constructor of steam automobiles, had a rather amusing experience not long ago. He had just finished a new disposition of one of his machines, and as it was a fine moonlight night, decided to try it at once, without waiting for the next day. So he started, with a mechanic, to make a tour in Vincennes Park, but as the machine went at a great speed they found themselves at the end of half an hour at Pont-Carré, a considerable distance from Paris and much farther than they had thought of going. As they had only a small supply of petroleum this soon gave out, and the question of the return trip was somewhat of a problem. They succeeded, however, in overcoming the difficulty. Stopping at the edge of the forest of L'Echelle, they modified as well as possible the receptacle of the petroleum burner and placed in it small pieces of wood to heat the water; this lasted for about a mile and a half, when they were obliged to stop and collect a new supply of wood. This operation was repeated over a distance of 12 miles, which they covered with great difficulty in three hours. Finally arrriving at a farmhouse they obtained a supply of petroleum, and the remainder of the trip was quickly made.

Electrical Notes.

More than ten thousand telephones in Detroit, Mich., were rendered useless on March 10 by the rain, which fell and froze during the entire morning. The thirty miles an hour wind which accompanied the rain raised havoc with the wires, weighed down as they were by ice. Officials of the Michigan Telephone Company estimated their total loss in the State at $20,000. Street-car service was greatly impaired during the morning by the ice. The storm was general throughout the southern part of the State, wires suffering everywhere.

Important experiments in electric traction are being carried out by the German government with a view to the possible introduction of electricity on some of the state lines. On an experimental line at Lichterfelde it has been found possible to convey directly to the locomotive currents of high tension which are transformed to the required working pressure on board the locomotive itself. Experiments on a considerable scale will be made on the Mariendorff-Zehlendorff line, which is about 14 miles long. The cars will be 87 feet long, will have 60 seats, and will be heavy. It is expected that a very high speed will be developed.

Mr. T. O. Moloney, in The Electrical Review, says that a piece of the best India mica was placed between two planed surfaces, and withstood an insulation test of 16,000 volts alternating current without fracture. The current was then removed, and the surface of the mica lightly coated with paraffine oil, and it was again placed between two planed surfaces. Under this condition it was found that it would break down at 9,000 volts alternating current. Another piece of India mica tested at lower voltages and under the same conditions as above was found to withstand 8,000 volts alternating, dry, and when oil was applied to break down at 4,000 volts alternating current. Tests were made, using three different grades of oil, paraffine, linseed, and lubricating, and all gave approximately the same results. The surface of the mica can be coated with water, and the insulation of the mica will not be lessened. A series of tests on mica immersed in oil showed the effects to be same as when coated.

Marconi is experiencing some trouble with the British Post Office department regarding the introduction of his system into the United Kingdom. By means of an Act of Parliament, passed in 1863, the government has a monopoly over any telegraph systems used in the country, since in this Telegraph Act it is stated that "the term 'telegraph' means a wire or wires used for the purpose of telegraphic communication, and any apparatus connected therewith." In view of the fact, however, that Marconi dispenses with wires, this act is quite inapplicable in his case, but as if anticipating the possibility of ethereal communication, the act was amended in 1869. It now reads: "The term 'telegraph' shall in addition to the meaning assigned to it in the Telegraphs Act of 1863, mean and include any apparatus for transmitting messages or other communication by means of electric signals." As an additional precaution against private enterprise, the Postmaster-General is accorded the sole privilege of transmitting telegrams within the United Kingdom.

Several attempts have been made from time to time to test the fairness and validity of the government's monopoly, but in every instance the latter has triumphed. Therefore it will be realized that Marconi is placed at an unfair disadvantage, and the scope of his experiments is exceedingly limited. If the postal authorities feel so disposed, they could compel the inventor to close all his experimental stations, since Marconi has never received the official permission for their erection. Two years ago the company which has the control of the patents applied to the Postmaster-General for the necessary license to use the system on land in England. The government has not yet replied to the application, probably under the impression that the granting of such a license would have been tantamount to submission on the part of the Post Office. Yet, although the government possess such a monopoly, they are unable to adopt Marconi's invention without awarding him compensation, either by purchasing the system outright, or by the payment of a royalty. Marconi is amply protected by the Patents Act. By this means the government is placed in the same position as a private individual. Marconi has patented all his inventions, and should the government utilize any of them, an infringement is committed, and the inventor can obtain redress in the usual manner. The result of this controversy is that at present a deadlock exists between the government and Marconi, the solution of which can only be obtained by the former awarding the inventor satisfactory financial compensation for the use of his system. This arrangement has been adopted by the Admiralty department, regarding the installation of the instruments in the navy. Doubtless some such arrangement will shortly be concluded between the government and the inventor, the effect of which will facilitate the introduction of wireless telegraphy into the postal system of the country within the near future.

Correspondence.

American Naval Construction.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of February 9 you were kind enough to discuss editorially my method of determining the military value of warships.

I thank you for your considerate article; since an international discussion of the question would do much to clear away present difficulties, and would lead to results which would be of value, not only to the constructor and naval officer, but also to the financial department of every government.

I have concluded my work in the March number of the Marine Rundschau, so that anyone can now carry out the mathematical calculations necessary to determine a vessel's fighting efficiency. In the periodical in question, I have also ranked American ships very high in the list of war vessels, and given the "Alabama" the value:

13.05 PA or 1.1 PAD.

I consider these values correct. Perhaps they would be still higher if I had better data at my disposal. So far as the comparative constructional fighting values are concerned, or, in other words, the values per ton of displacement, the "Alabama" must stand high in the list. For the naval constructor these comparative values are of the utmost importance.

I cannot too highly compliment your worthy and famous Chief Constructor, Rear Admiral Hichborn, on his skill in giving to a vessel of the small displacement of 11,525 tons so large a fighting value as 1.1, especially when it is considered that the "Mikasa," a vessel of 15,200 tons displacement, has but a fighting value of 1.0.

With the last sentence in your editorial I cannot agree. I hope that my last published essay may do much to clear this very important question of many obscurities, and that the possibility has been shown of constructing a fighting ship on mathematical and scientific principles. OTTO KRETSCHMER,

Chief Naval Constructor, German Imperial Navy.

Berlin, March 19, 1901.

Armored Cruiser Discussion.

[We have received a lengthy communication from Mr. Paul D. Emmons replying to criticisms which appear in our issue of April 6 of his proposal to substitute 7-inch guns for the 6-inch guns in the batteries of our new armored cruisers. The letter which is too long for insertion in the SCIENTIFIC AMERICAN will be found in the current issue of the SUPPLEMENT. —ED.]

Explosive Effects of Bullets.

The question investigated by C. Cranz and K. R. Koch in Ann. d. Physik, was whether the "explosion" of tissues produced by a high-velocity infantry bullet takes place while the bullet is still within the body, or after it has already left it. To imitate the action of blood-vessels while having recourse to a clearly defined physical structure, the authors employed tin cylinders filled with water, and closed at one end with parchment, and at the other with an indiarubber membrane. The rifle experimented with was a new 6 millimeter model made by Mauser at Oberndorf, and having a muzzle velocity of 100 meters in excess of any hitherto used. The method of taking the photographic records was a modification of that devised by Mach. The circuit of a battery of Leyden jars was interrupted by two spark-gaps. One of them lies within the liquid, or in its immediate neighborhood. Its knobs are covered with glass tubes, so that the spark can only pass when they are shot through. The other spark-gap lies in front of a concave mirror in such a position that its image falls on the shutter of the recording camera. This gives a silhouette of the water-vessel on the sensitive plate. In some of the experiments, the bending aside of the bullet by the water made it necessary to have another method of making the circuit. This was then done by the mechanical action of the issuing water-jet in bringing one electrode into contact with the other. The general result of the experiments is that the "explosion" takes place some time after the bullet has left the body. The authors discuss the various theories framed to account for the phenomenon. It is not due to evaporation, as the temperature of the bullet in no case exceeds 150 degrees. The introduction of large masses of gas into the body has no evidence to support it. The rotation of the bullet is too slight to produce the effect, and the deformation of the bullet cannot be the main cause, as explosive effects are produced when there is no deformation. The only remaining theories are those based on sound waves and on the acquired velocity of translation. The authors favor the latter. Part of the kinetic energy of the bullet is transferred to parts of the body in the vicinity of the path of the bullet, and takes some time to produce its effect. But when this takes place a considerable portion of the body is torn away from the anterior portion.

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