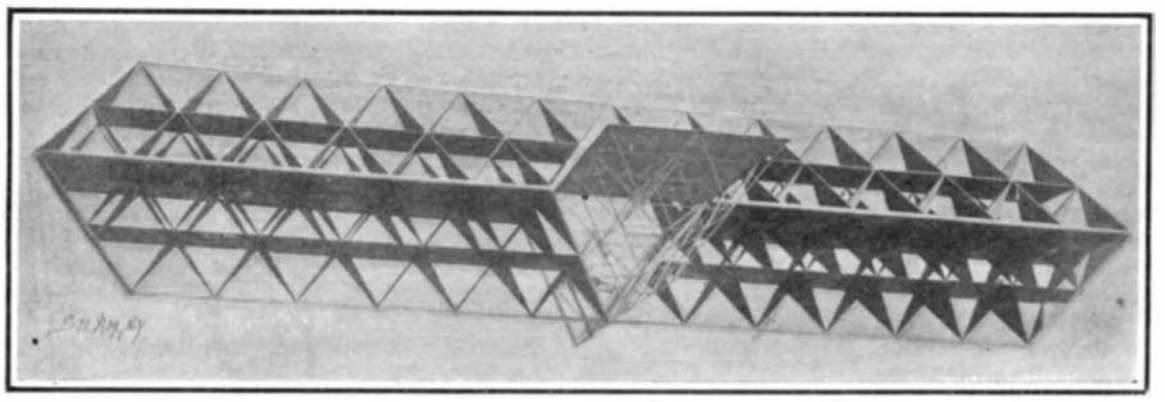
vacuum tube may be held in the mouth, and a current passed through the lamp lights it and then continues on its course, passing through the membranes of the mouth, which are perhaps the most sensitive of any in the body, yet no sensation whatever is experienced. A half-dozen incandescent lamps may be lighted with current passing through the body and no sensation is felt although instant death would result were the rate of oscillation reduced within certain limits.

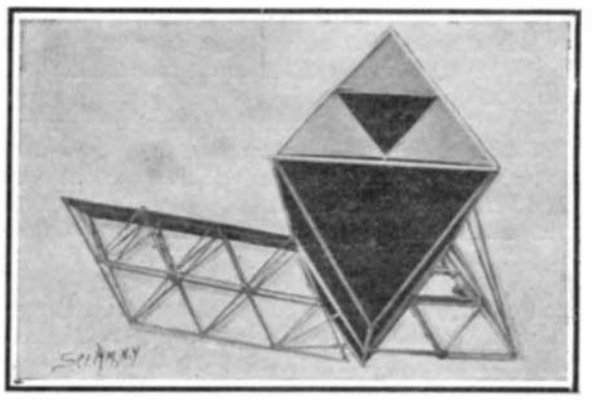
To show the impedance a copper bar of large diameter offers to a high-frequency current, an incandescent lamp is short-circuited across the former and the current is thus given the choice of two paths, an apparently easy one of small ohmic resistance and high impedance through the copper rod, or a seemingly more difficult one of large ohmic resistance and low impedance through the lamp. While an ordinary current would of course choose the former, the extraordinary current traverses the latter path.

The practical application of these discharges is found in radiotherapy. Their use is being extended more and more, and by many it is considered a rational method in therapeutic practice. Heat, light, and electricity when properly applied have accomplished surprising results. With the apparatus shown not only are all the various remedial manipulations of electricity available, but current is also supplied suitable for producing the X-rays, ultra-violet light, etc.

THE AERO CLUB OF AMERICA'S EXHIBIT OF AERONAUTICAL APPARATUS.

A most interesting exhibit, in connection with the Sixth Annual Automobile Show held recently in the 69th Regiment Armory, was that made by the newly-formed Aero Club of America. This exhibit was the most complete of its kind ever held in any part of the world, for all types of flying machines, balloons, and airships were represented. In the same room with Santos-Dumont's No. 9 airship was to be seen one of the original gliding machines of Herr Otto Lilienthal, as well as the gasoline and steam-propelled aerodromes of Prof. Langley and the motor-driven aeroplane models of Herring and Hargrave. Other apparatus shown consisted of Prof. Bell's tetrahedral kite, Ludlow's combined box kite and aeroplane, Myer's electrical torpedo, and Kimball's heliocoptere. The original Hargrave box kite was also shown, as well as numerous models designed by Herring and Chanute. Besides these very complete exhibits of apparatus, the walls of the room were covered with a large collection of photographs showing the machines of other inventors, such as Whitehead, Berliner, and Santos-Dumont; and other photographs showing airships and balloons in flight, together with bird's-eye views taken from the same. In another room cinematograph exhibitions were given twice every day. The views shown consisted of motion pictures of the Vanderbilt automobile race, the Mount Washington hill climb, balloon ascensions, and experiments in raising aeroplanes when towing them by means of a motor boat. In showcases placed in the exhibition hall were seen primitive models of flying machines from the Patent Office at Washington, light motors and other appliances for aeronautical work, together with a collection of books bearing on the subject. Among the exhibits of apparatus of historic interest were the large wood propellers which Mr. Her-

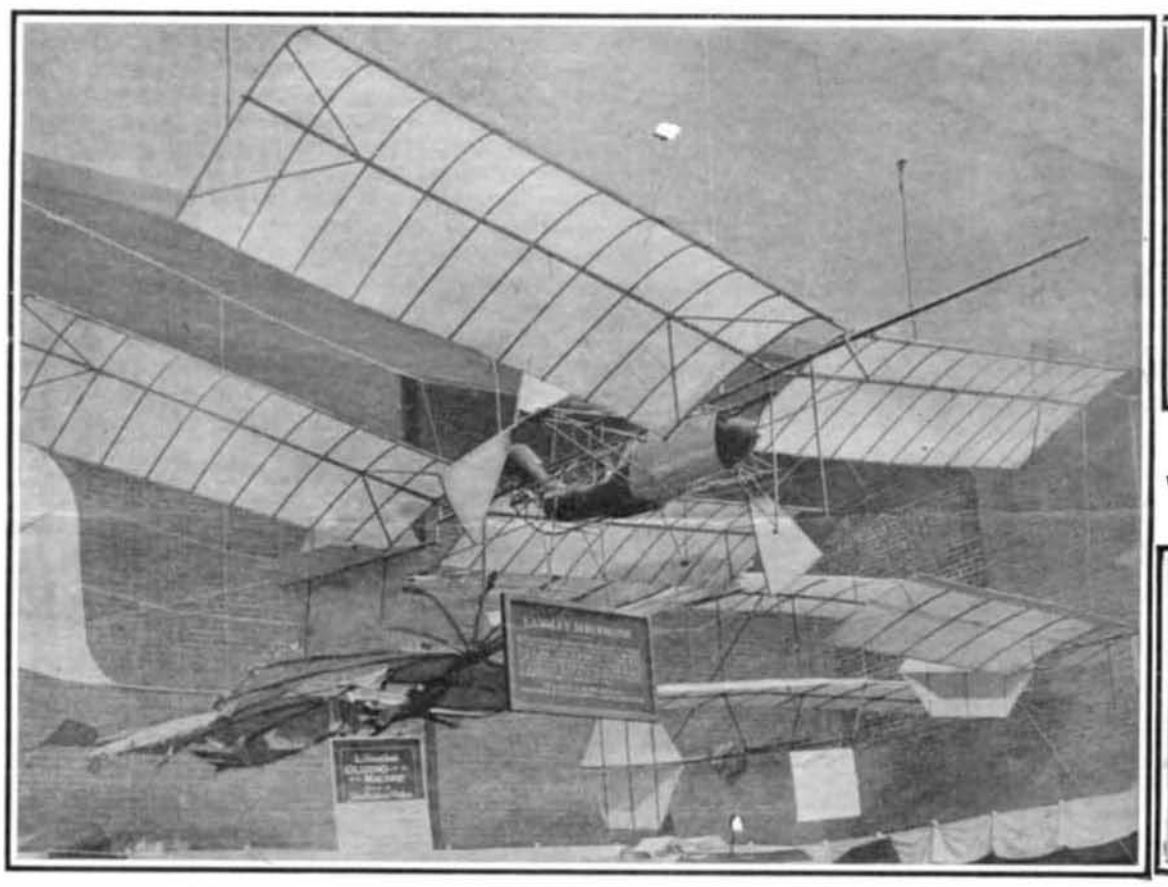




Side and End Views of Prof. Bell's Tetrahedral Kite, Which, When It is Released in Mid-Air, Descends in a Series of Curves, and Sometimes Describes a Complete Circle Like a Soaring Bird.

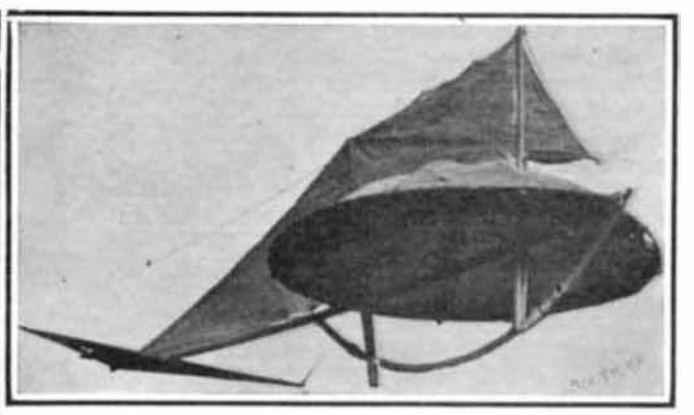
This photograph shows the rear of kite, which is made up of tetrahedral cells constructed of spruce sticks 4 mm. (0.157 inch) square and 25 cm. (9.842 inches) long, bound together with fine twine and covered with red silk. The weight of a single cell is 9½ grms., or ⅓ of an ounce.

This view shows the tail tipped upward, which is accomplished automatically by a pendulum in the bow when the kite makes a dive.



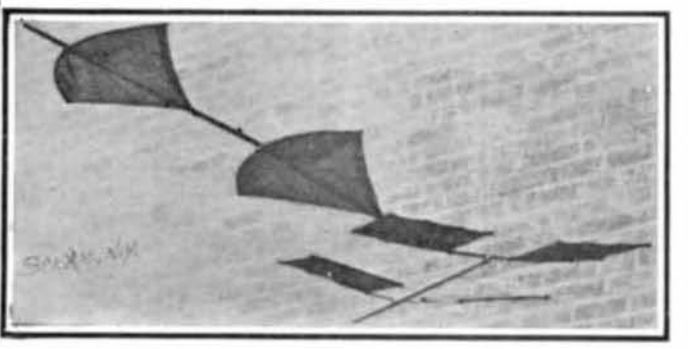
Langley's Steam Aerodrome—the First Power-Driven Aeroplane to Fly.

The first successful flight of this machine was at Quantico, Va., on May 6, 1896. The rudder at the left of this picture forms part of Lilienthal's gliding machine. In the right-hand corner of the room is seen the Herring-Arnot two-surface aeroplane which has been used successfully by Mr. Herring and the Wright brothers.



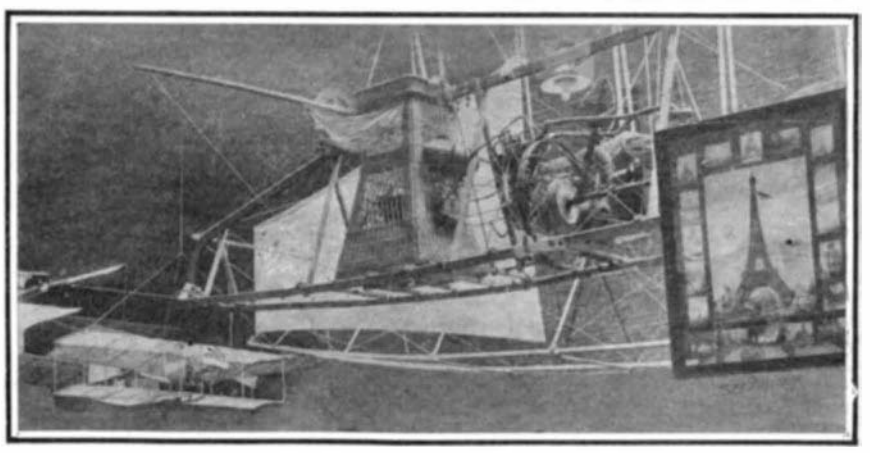
Herring's Dome Kite of 1896.

With this kite the center of pressure is almost constant with widely varying angles of inclination. Its lifting power is also high.



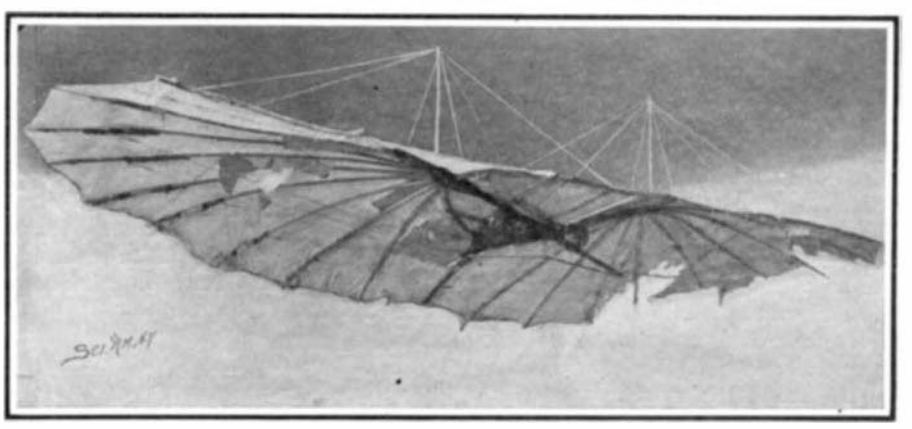
Samples of Brown's Bi-Planes.

This type of aeroplane consisting of two following surfaces was invented about 1878. Langley's aerodrome was built on this plan. But 20 pounds per horse power can be lifted with this type of machine where from 100 to 150 pounds per horse power can be lifted with the superposed plane type.



The Motor and Basket of Santos-Dumont's No. 9 Airship.

A blower is arranged to blow on the motor cylinders to cool them properly. A large bicycle wheel acts as a flywheel and the shaft carrying the propeller runs forward to the front of the framework. The model two-surface aeroplane in left-hand corner is a motor-driven model which is said to have made numerous successful free flights.



One of the Original Lilienthal Gliding Machines with Which He Made Hundreds of Successful Flights.

This machine has a rudder, which is shown in the view of Langley's aerodrome. Lilienthal succeeded in steering in a sharp curve to right or left with this machine.

ring used on the first motor-driven, man-carrying aeroplane to make a flight from the ground. This machine, according to Mr. Herring, was propelled by a small compressed-air motor. On October 22, 1898, he informs us that it flew with its operator a distance of 72 feet in 8 seconds against a 25-mile-an-hour wind. Another exhibit of great interest at the present time, in view of the claims of remarkable flights made by the Wright brothers last summer, was the four-throw crankshaft and flywheel of the motor said to have been used on their machine when, on December 17, 1903, they made their first flight with a motor-driven aeroplane at Kitty Hawk, N. C. These experimenters claim to be using the same cylinders with their latest machine, the motor of which they have fitted with a lighter crankshaft. The crankshaft shown weighed in the neighborhood of 30 pounds.

Among the model self-propelled aeroplanes shown, those of Prof. Langley should undoubtedly have first mention. The steam-driven machine flew about half a mile over the Potomac River at Quantico, Va., a little less than ten years ago, or on May 6, 1896. This was the first flight of a motor-driven aeroplane. The gasoline-propelled model (which has a five-cylinder air-cooled motor, the cylinders being arranged in a circle) made numerous shorter flights in August, 1903. Prof. Langley's models are constructed on the following plane principle. The original inventor of this device, which was first brought out about 1873, was Mr. Brown, and samples of Brown's "bi-planes," as they are termed, are shown on page 93. A lift of only about 20 pounds to the horse-power is possible with this system, as against a lift of from 100 to 150 pounds per horse-power with the superposed plane type. In actual practice Langley obtained about 18 pounds lift. Langley's complete steam machine weighed 30 pounds, while the motive plant developed 11.4 B. H. P. The gasoline model was one-quarter the size and one sixteenth the weight of Langley's man-carrying machine. It weighed 58 pounds, of which 10 pounds was in the 10 horse-power engine. As to the actual flights of these machines, there can be no question, for the one on the date mentioned was witnessed by Prof. Bell, and photographs were taken of the machine in flight.

Another interesting model is that exhibited by Mr. Herring, and which he claims has made numerous successful flights. When tethered to a high pole with a long cord, this machine is said to have flown 15 miles in a circle in December, 1902, and to have stopped only when the gasoline supply gave out. A single-cylinder, air-cooled gasoline motor having mechanically-operated inlet and exhaust valves and a make-and-break igniter, all worked from a single cam, and carrying a small propeller on its crankshaft, was shown on this machine. The weight of the motor was said to be only 2 pounds, and its maximum horse-power 0.51 at 3,400 R. P. M. In flight, however, the engine only made about 850 R. P. M. and developed but 0.07 horse-power. The aeroplanes of this model (which is shown in the lower left-hand picture on the preceding page) were 5¼ feet long by 14 inches wide, and the 19-inch propeller which was fitted drew them through the air at a speed of about 30 miles an hour. This machine is of the usual rectangular, curved, superposed plane type invented by Chanute and Herring about the year 1896. Its successful operation is said to be due to an equilibrium-maintaining device which its inventor prefers to keep secret. No photographs of this or of larger man-carrying machines in flight were shown, nor has any trustworthy account of their reported achievements ever been published. A single blurred photograph of a large birdlike machine propelled by compressed air, and which was constructed by Whitehead in 1901, was the only other photograph besides that of Langley's machines of a motor-driven aeroplane in successful flight. In order at least partially to substantiate their claims, it would seem as if aeroplane inventors would show photographs of their machines in flight. This has been done by Mr. Maxim and Prof. Langley; and on account of his desire to secure photographs of his tetrahedral kites in mid-air, Prof. Bell uses red silk in their construction instead of nainsook, which he prefers, but which, owing to its light color, is difficult to photograph.

In contrast to the great secrecy of the later aeroplane experimenters, should be noted the free manner in which that first great experimenter in gliding flight, Otto Lilienthal, gave the results of his experiments to the world. One of the early gliding machines used by him in 1893 was exhibited, and a photograph of this machine is to be seen on page 93. Had it not been for his untimely death in 1896, from the breakage of his machine while in flight, there is scarcely any doubt that he would have solved the problem of the motor-driven aeroplane some years ago; for he was not only a thorough mathematician and physicist, a clever constructor and mechanical engineer, but he was also possessed of that daring and physical dexterity which is a valuable aid to one attempting to solve such a problem.

One of the most interesting exhibits was Prof. Bell's tetrahedral kite shown on the preceding page, and a 408-cell model of the huge 1,300-cell man-carrying kite "Frost King," which was fully described in Supplement No. 1432, and which carried over 280 pounds. Despite the apparent frail structure of these tetrahedral cells, their great strength when assembled was demonstrated by the placing of a 190-pound man upon a mass of 100 or more without damage. The kite we illustrate, by means of its tipping tail worked by a pendulum in the bow, will descend in long graceful curves when released in mid-air, and several times it has described complete circles before alighting, in much the same manner as does a soaring bird.

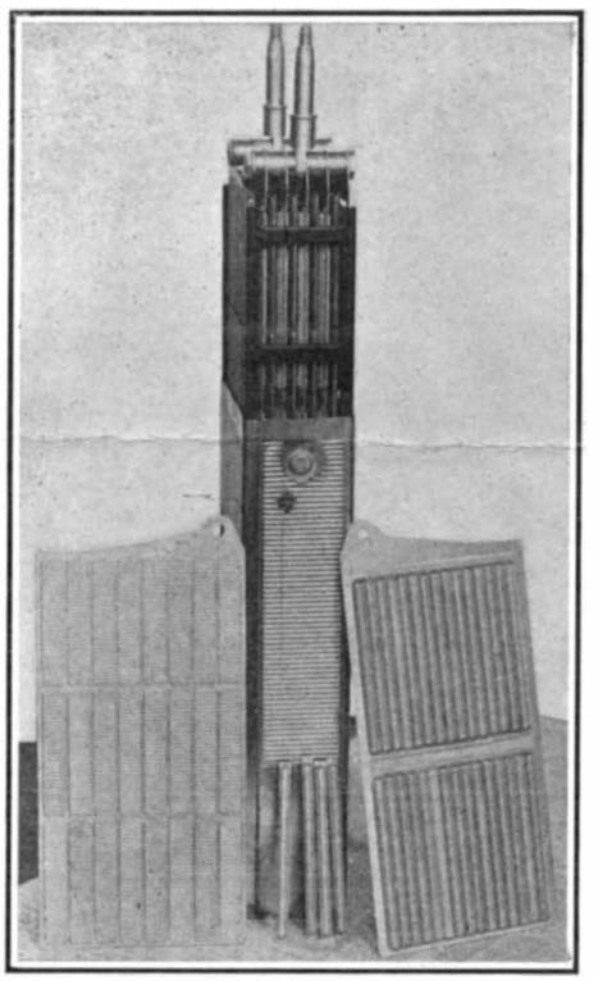
Among other interesting exhibits were examples of balloon wicker baskets equipped with appliances for sketching and photographing the country, and for making weather observations. The frames of two dirigible balloons, the "Santos-Dumont No. 9" and "The California Arrow," were exhibited. Both were equipped with air-cooled gasoline motors of the lightest construction.

A complete set of apparatus used by the weather bureau formed still another extremely interesting exhibit.

The greatest credit should be given to the Committee of the Aero Club, and especially to its able secretary, Mr. Augustus Post, for the exhibit made at the Armory. Not only will this exhibit tend to stimulate interest in the art of flying, but, followed by the active interest of the Club in matters pertaining to the art, it should greatly promote the development and perfection of the practical flying machine.

CHANGES AND IMPROVEMENTS IN THE EDISON NICKEL-IRON STORAGE CELL.

The illustration shown herewith makes apparent the changes in construction of the nickel, or negative plate,



THE IMPROVED EDISON STORAGE CELL.

Note the tubes for holding the active material of the nickel plate now used in place of the flat briquettes, which are still used in the iron plate. The seam where the jar is electrically welded is seen at left of the fluting. The plates are set in hard rubber frames and separated by small square strips.

of the Edison alkaline storage cell. Actual use of some 175 sets of automobile batteries has demonstrated that there is a loss in capacity, due to the separation of the active material from the containing flat cases of the nickel plate. A new form of briquette, consisting of a rolled tube of perforated, nickel-plated, sheet steel, is soon to be used. These tubes are tightly packed with active material by a special machine, and they are then clamped into place in the plate by means of their twisted ends. The tubes are made from a small sheet of metal, which is rolled into the tubular shape and has its two ends joined together. Thus there is a joint running the entire length of each tube, but by twisting the ends of the tube and clamping them, it is impossible for any appreciable expansion of the latter to occur, and separate it from the active material within. A new form of binder other than flake graphite has been discovered, and this, together with the new construction, is said to increase the total capacity of the cell from 10 to about 15 watt-hours per pound of complete cell. A 21 per cent solution of caustic potash is used in these cells, and three sizes are made, the smallest having a capacity of 110 ampere hours at a 30-ampere rate, and requiring 150 ampere hours to recharge it. The improvement in capacity will place the Edison cell at the head of the list for lightness. Regarding its durability, Mr. Edison believes the new plates will last for four years at least in actual service, and that they can then be renewed for about one-third their first cost.

Electrical Notes.

According to the latest news which we receive concerning the electric installations in Japan, we find that all the cities whose population is above 10,000 inhabitants are lighted by electricity, and besides many of the towns are now equipped with electric tramway lines on the trolley system. Owing to the fact that the country is of a mountainous character, there are waterfalls to be found in abundance, and this naturally contributes to a great extent in the development of electrical enterprises. At present about 30 per cent of all the electric plants are operated by water power. The country is also greatly favored in possessing extensive coal mines, so that the cost of running steam engines is not high. Among the large electrical enterprises of Japan we may mention the Tokio Electric Light Company, which has a station of some 20,000 horse-power capacity at a distance of 20 miles from the capital. The Tokio Electric Power Company has an electric plant of no less than 40,000 horse-power, and the municipal station of Tokio has a capacity of 2,500 horse-power. At Osaka, which is one of the leading commercial cities, there are several electric stations already running. One of the recent projects to be carried out by the Uji River Hydro-electric Company relates to installing a water power plant at 20 miles from Osaka, and it will use upward of 35,000 horse-power.

According to recent information relating to the Jungfrau electric road, the tunnel which ends at the Mer de Glace was finished about the middle of June. At present, the stations of the line comprise the starting point at Petite Scheidegg (6,710 feet altitude), the second station of Eiger Glacier (7,550 feet altitude), third, Rotstock (8,220 feet), Eigerwand (9,330 feet), and lastly the Mer de Glace (10,280 feet altitude). The service of the road is assured by six electric locomotives of the three-phase type, of which three have been built by the Brown-Boveri Company and the remainder by the Oerlikon Company, both of Switzerland. The current for the road, which takes 7,000 volts primary tension and 500 secondary, comes from the large hydraulic plant of Lauterbrunnen. A fall on the Lutschine River furnishes some 2,500 horse-power to the turbine. According to Guyer and Zeller's project the new part of the electric road, which remains to be built, is to run in a straight line toward the west and rise on a low grade to the station of Jungfrauenjoch (11,058 feet altitude). From there it will reach the Jungfrau station which is to be cut in the rock. This latter station will be equipped with an electric elevator which is to run up to the highest point of the mountain and lies at an altitude of 13,545 feet.

Our readers will doubtless remember the description of an improved and simplified type-setting telegraph apparatus called "teletyper" (*Ferndrucker*) we published in these columns some time ago. We learn from an article in the Elektrotechnischer Anzeiger that after a central station had been installed two years ago to enable subscribers to the novel system to communicate with each other as well as with the Wolff telegraph office and other information bureaus, the same service is to be utilized now for general telegraphic purposes. The imperial postal department has in fact ordered a set of teletypers to be used in connection with Berlin intra-urban telegraphy. The practice so far usual in connection with urban telegrams was to convey these through a network of pneumatic tubes. Though the speed of pneumatic dispatch carts, equal to that of express trains, be considerable, this means of conveyance of the records still requires a certain amount of time. The pneumatic tubes radiate toward the telegraph office, where they are combined. Though immediate connections between the various stations be available, there was the necessity of shifting the telegraph records. The adoption of teletypers will doubtless accelerate the dispatch of telegrams. A new exchange is to be installed for this purpose in connection with the central telegraph office. All the pneumatic dispatch offices are to be equipped with a teletyper and to be connected immediately to the central telegraph office. It may be mentioned that the number of these offices amounts to 67. The teletypers are intended for the beginning to convey the intra-urban telegrams which are largely used in Berlin. Practice will show in how far this scheme would be available also for the conveyance of outside telegrams from and to the central telegraph office. Like the telephone, the teletypers can communicate immediately with each other, while capable of simultaneous communication with the same station, whence the same telegram can be transmitted to all of them. As the record is obtained simultaneously in both the transmitting and receiving apparatus, there is every facility of checking its correctness. The main advantage of the teletyper is, however, its ease of manipulation, requiring but little skill.