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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE NEW EDISON STORAGE BATTERY.

The first authentic account of the new Edison storage battery was presented at the eighteenth annual meeting of the American Institute of Electrical Engineers, held in New York May 21. The paper was read by Mr. Arthur E. Kennelly. It is well known that the history of the storage cell is essentially that of the lead cell discovered by Planté in 1860, in which lead peroxide is the depolarizing substance. An enormous amount of labor has in the aggregate been expended upon the improvement of this cell in the hands of experimentalists. As a result of that labor the storage battery has at last become a recognized adjunct to direct-current central stations; but it has limitations that seem to withstand further attempts toward improvement. Of late years hardly any success has been met with in the direction of reducing its weight for a given energy-storage capacity without detriment to endurance, and this weight is the great drawback of the storage battery in electric storage battery traction, and has been the principal obstacle to its advance in this direction for the past twenty years. In practice the storage energy per unit mass of the modern lead battery may be expressed as follows: The battery weighs from 124.5 pounds to 186.5 pounds per horse power hour at its terminals. While it is possible to increase the energy per unit mass by making the electrodes very light, this has always been found to be followed by a very heavy deterioration. Many attempts have also been made to perfect storage cells of the alkaline zincate type, but the great difficulty of depositing zinc in coherent form from the solution, as well as the lack of a depolarizer that shall be insoluble in the electrolyte, has stood in the way of this cell's success. Mr. Edison set himself to the task of finding a cell which should possess the following advantages: absence of deterioration by work; large storage capacity per unit of mass; capability of being rapidly charged and discharged; capability of withstanding careless treatment; and inexpensiveness. The negative pole or positive element of Mr. Edison's cell, corresponding to the zinc of a primary cell or the spongy lead of a secondary cell, is iron. The positive pole or negative element, corresponding to the carbon of a primary cell or lead peroxide of a secondary cell, is a superoxide of nickel, believed to have the formula NiO₂. The cell is, therefore, a nickel-iron cell, a name which suggests the structural material—nickel-steel. The electrolyte is potash, viz., an aqueous solution containing 10 per cent to 40 per cent by weight, but preferably 20 per cent of potassium hydroxide. In practice with the ordinary storage battery the storage-energy per unit mass of the modern lead battery is from 4 to 6 watt hours per pound of battery; but the storage capacity of the Edison cell per unit of total mass of steel is 14 watt hours per pound. Expressing the same statement in another way, the weight of the battery per unit of initial energy at the terminals is 53.3 pounds per E. H. P. hour. If the stored energy in the ordinary storage battery available at the terminals were all expended in gravitational work, a battery could raise its own weight to a vertical distance of from 2 to 3 miles. With the Edison battery it could lift its own weight to a vertical distance of approximately 7 miles. The normal discharge period is 3½ hours. The cell may be discharged at a relatively high rate in approximately one hour. Charging and discharging rates are alike. That is to say, the cell may be charged at the normal rate of 3½ hours, or it may be charged at a relatively high rate in one hour with no great detriment beyond a somewhat lower electrical efficiency.

The positive and negative plates are mechanically

alike and can scarcely be distinguished by the eye. They differ only in the chemical contents of their pockets. The construction of the battery is fully described in Mr. Kennelly's paper, which is published in full in the current issue of the SUPPLEMENT.

The cell is an oxygen-lift. Charging pulls the oxygen away from the iron and delivers it temporarily to the nickel. The condition is then stable, until the circuit of the cell is completed. The discharge then allows the oxygen to fall back from the nickel to the iron with the natural affinity of iron and oxygen. This action is very different from that which takes place in the lead storage cell. In the new Edison cell the theoretical action of the potash solution is merely to provide the proper channel through which the oxygen ions may travel in one direction or the other—positive plate to negative plate in charge, and negative plate to positive plate in discharge. Secondly, the amount of solution needs only to be sufficient to fulfill mechanical requirements. As regards cost it is believed that the new cells can be produced at a price per kilowatt hour not greater than the prevailing price of lead cells.

LAST OF THE CABLE SYSTEMS IN NEW YORK.

By the time this issue is in the hands of our readers, the cable system of street traction which has done such yeoman service in New York city will be a thing of the past, and electrical traction will have taken another important step toward that day when it will be the only method of traction employed in the transportation of passengers in New York city. It was just a quarter of a century ago that the first cable road built on this continent was constructed in the city of San Francisco, and the system has fully lived up to the high hopes which were entertained of it when the San Francisco lines were opened. Although subsequent to that date, and prior to the inauguration of the Broadway line in New York city, electric traction had begun to assert itself as a practicable system, it was not at first believed to be equal to the successful handling of the enormous traffic which was certain to be encountered on Broadway at the time the cable line was put in. Even as late as the year 1897, President Vreeland, of the Metropolitan Street Railway Company, stated to the editor that the management of that road considered that the cable was better adapted than electrical traction for handling the extremely heavy traffic of that thoroughfare. An experimental underground trolley line, however, was at that time in operation on Lenox Avenue, and the Metropolitan Street Railway Company was carrying on a course of experiments, which have resulted in the equipment of the whole of their north and south lines with the underground trolley system. The first important thoroughfare to be so equipped was the Fourth Avenue and Madison Avenue line. Following this came the electrical equipment of the Sixth Avenue and Eighth Avenue lines. The results, judged from any and every standpoint, have been so invariably successful (the capacity of the line being enormously increased and the operating expenses reduced) that it was only a question of time when the steel cables would be withdrawn from the conduits and the electric cables put in their place. The preliminary work of installing the necessary manholes, insulators, etc., was done last year; and now, with a very brief interruption to traffic, the cable cars have been withdrawn, and the standard electric cars of the company placed on both the Lexington Avenue and Broadway systems. New York city now stands at the very front of the great cities of the world in the matter of rapid, cheap, and convenient street railway service.

OPENING OF THE PAN-AMERICAN EXPOSITION.

The opening of the very complete and altogether beautiful Exposition at Buffalo was marked by several features which render this Exposition unique among the many which are being conceived and carried out with ever-increasing frequency—a frequency which is, in itself, a striking sign of the commercial activity and development of our times. Among the features which entitle this latest effort to distinction are the fact that in conception and execution it is practically the work of a single city; and that in the combined harmony and strong individuality of its grounds and buildings it surpasses any like undertaking that preceded it. Moreover, the Exposition, which was so happily dedicated on the 20th of May, acquires distinction from the fact that there is about its aims and purposes a definiteness which has been lacking in some of the expositions, large and small, which have recently been held.

The proposal to make the Buffalo Exposition distinctly Pan-American seems to have appealed from the very first to the country at large, and to the many republics which are embraced under the comprehensive name adopted. The United States government gave practical proof of its indorsement by an appropriation of \$500,000, and emphasized its approval by the statement: "It is desirable to encourage the holding of a Pan-American Exposition on the Niagara frontier, in

the city of Buffalo, fittingly to illustrate the marvelous development of the Western Hemisphere during the nineteenth century by a display of arts, industries, manufactures and the products of soil, mine and sea." Invitations were extended by the national government to the various governments of the Western Hemisphere, from Canada on the north to the Argentine Republic on the south. The handsome assistance of the national government, and the hearty and ready co-operation of the governments of the Western Hemisphere found a quick response from the citizens of Buffalo. The matter was taken in hand with such thoroughness that the necessary funds, estimated at \$10,000,000, for the larger scope which the plans of the Exposition thereupon took on, were readily forthcoming. New York State appropriated \$300,000 and other appropriations, ranging from \$75,000 by Illinois to \$10,000 by North Dakota, were voted by the various States, with the result that the sponsors of the Exposition were enabled to plan the grounds and buildings on a scale, and with an architectural beauty and finish, which entitle it to rank as one of the largest, and as many will think, the most harmonious and beautiful display of the kind ever attempted. Before leaving the question of finance and management, it is only just to say that the successful carrying out of such an ambitious scheme is the highest possible tribute to the energy, the resourcefulness, and the great public spirit of the citizens of Buffalo and the western section of New York State.

A fact which has contributed largely to the success of the Pan-American Exposition was the timely recognition on the part of the committee in charge of the planning of the grounds and buildings, that both the landscape treatment and the architectural and sculptural elements of the Exposition should be made as highly distinctive and characteristic as possible. Since this was to be an American exposition, it was decided to plan the buildings so that they should be strongly suggestive of the architecture of the new world. At the same time, realizing that in the aptly-named "White City" at Chicago the possibilities of treatment entirely devoid of color had been perhaps exhausted, it was decided to give a general color treatment to the whole group of the Pan-American building as such. The preparation of plans along these lines was intrusted to a board of architects whose work can be appreciated only by a visit to the Exposition itself.

In planning the Exposition the board were favored by the fact that they were not cramped for room. The ground at their disposal being of generous proportions, and of a fairly rectangular shape, they did not have to conform to the layout of the buildings and the ornamental features of the ground to any hard-and-fast, predetermined lines. The grounds are about one mile in length and half a mile in width. At the Buffalo end the landscape features are greatly enhanced by two large lakes of water, surrounded by gently sloping and richly wooded grounds, in which are to be found the two permanent buildings of the Exposition—one the Albright Art Gallery and the other the New York State building. Both of these are built of gray-white marble and are classically treated. Passing down through the center of the Exposition grounds, entrance is made to the magnificent approach to the Exposition buildings; and here one has to admit, even with the beauties of the Paris Exposition of last year fresh in mind, that the present effort is more successful, not merely in one, but in every element of its landscape and architectural effects. As the eye ranges down through the long perspective of the Fore Court, the vast Esplanade with its accommodations for a quarter of a million people, the Court of Fountains and the Grand Basin, until it rests upon the stupendous pile of the Electric Tower, which last may truly be called the dominating feature of the whole Exposition, one feels that there is a pervading harmony and proportion which has too often been wanting in displays of this kind. Particularly happy is the way in which the water effects have been worked in among the assembled buildings, whether in the way of winding canals, or broad, placid lakes, or laughing fountains. As one wanders from plaza to courtyard, from courtyard to boulevard, one has a feeling that everything is just about where it should be, that nothing could be omitted without a sense of loss, nor added without a sense of crowding and over-elaboration. Amid so much successful treatment, it is difficult to select any feature for special mention; but no doubt there will be a consensus of opinion that the bridge between the Fore Court and the Esplanade, and the Electric Tower with its grandly curving wings springing sheer from the clear waters of the Grand Basin, are two of the most striking among the many beautiful effects which distinguish the Exposition.

Dedication day was a pronounced success, both in respect of the large attendance, which was over 101,000, and the high character of the addresses which marked the opening ceremonies. As was natural, the keynote of the speeches was to be found in the name which is borne by the Exposition. It was certainly pardon-