the outside of the track as required. At level crossings, stations, etc., the collector rail will be protected by two creosoted boards bolted against distance pieces on each side of the rails. Under normal conditions the collector rails will have no protection, but holes for fixing this are being punched in all the collector rails, so that protecting boards may be readily applied at any place found desirable. Instead of adopting a second collector rail in the center of the track for the return current, as has been done in some cases, it was found that the Board of Trade requirements could be more economically met by bonding the running rails, but the position of the single collector rail has been so fixed that a return collector rail can be installed between the rails at any future time should this prove desirable in the event of great extension of the traffic on these lines.

ELECTRIC POWER SUPPLY.

Current will be supplied to the collector rail from five substations located at Pandon Dene, Wallsend, Cullercoats, Benton and Kenton. Fourteen 800-kilowatt rotary converters will be installed, distributed among the various substations so as to best meet the load. The substation containing the largest plant capacity will be Pandon Dene, where four of these rotaries will be installed. In order to meet the excessive fluctuations of the load each rotary has been specially designed to operate without serious sparking at an overload of 100 per cent for ten minutes and at an overload of 200 per cent momentarily. The main static transformers are of the single-phase, oil-insulated, self-cooling type. To each rotary converter is coupled a small induction motor fed by a special transformer, and the rotary converter is started up by means of the induction motor until it attains the synchronous speed of the rotary, when it is switched into the high tension busbars in the usual way. The substations will receive their supply of energy at a pressure of 5,500 volts, three-phase, through three-core, paper-insulated, lead-covered cables laid solid in wooden troughs along the railways.

The new rolling stock will comprise motor and trailer coaches, and will be of the open-corridor type, lighted and heated by electricity. Each motor coach will be equipped with two G. E. 66 motors, each rated at 150 horse power, both motors being carried on one bogie truck. The unit train will be composed of two motor coaches with one trailer coach between them, this being strengthened when necessary by the addition of another unit train. The motor coaches will have drivers' compartments at one end only, but a master controller will be fitted in the vestibule at the other end also, so that the coach may be driven from this end if necessary.

The ordinary accommodation train will take about 23 minutes for the journey from Newcastle to Tynemouth, the average speed being about 22 miles per hour, including stops. Express trains will reduce this time to 15 minutes.

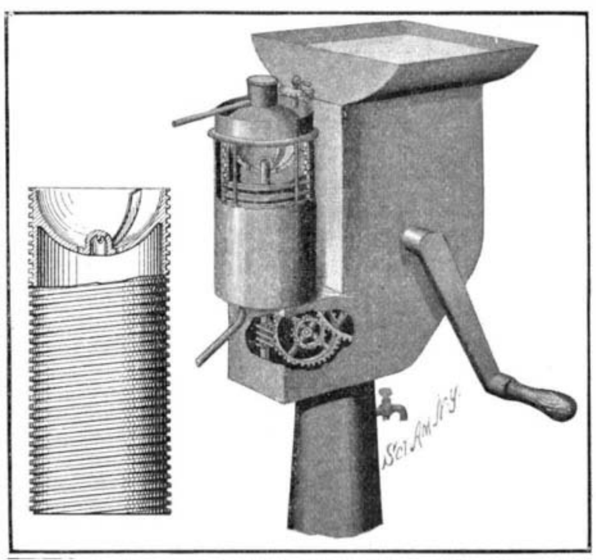
The Quayside branch line, which is used for freight only, is also being equipped for electrical operation, the object being to overcome the ventilation difficulties which now prevent the line from being fully utilized owing to its being for the most part in tunnels and on a heavy gradient. There will be two electric locomotives for the Quayside branch, and these will be equipped in the same way as the motor coaches with multiple unit controller, Westinghouse air brakes, etc. Each locomotive will be capable of starting with and hauling a train weighing 150 tons up a gradient of 1 in 27 at a speed from 9 to 10 miles per hour.

Instead of constructing a generating station of their own the railway company will purchase their current from the Newcastle-on-Tyne Electric Supply Company, Limited. A portion of this current will be generated at the existing Neptune Bank station at Wallsend, but this station is now nearly loaded up and the supply company have in course of erection a larger station situated at Carville, about half a mile further down the river, and it is from this new generating station that the bulk of the supply to the railway company will eventually be obtained. The designs for this new station are now completed and the contracts let. The generating plant is to consist of steam turbo generators, each of 3,500 kilowatts, with an overload capacity of 5,000 kilowatts for two hours, and the order for these has been obtained by Messrs. C. A. Parsons & Co. As the space occupied by such a set compared with that taken up by the boilers necessary to supply it with steam is so small, the usual arrangement of placing the boiler house parallel with the engine room has been abandoned, and instead each turbine unit will have a separate range of boilers running at right angles to the engine room. Every two ranges of boilers will be combined in one centrally-fired boiler house and will be provided with independent flues, economizers, induced-draft fans, and a short iron chimney.

Texas's unique star-shaped building at the World's Fair is receiving its staff ornamentation. Its peculiar shape and its great dome render it conspicuous among the State structures.

IMPROVED CREAM SEPARATOR.

An improved cream separator of the centrifugal type forms the subject of a patent recently granted to Mr. Henry H. Stüssy, of Beresford, So. Dak., Box 154. The invention embodies some novel ideas, which are very ingenious and interesting. The separator proper has been broken away in our illustration, to show the interior details, which comprise a stationary cylinder within which an inner cylinder is mounted to rotate. The stationary cylinder is formed with a dome-shaped top, opening into a small receptacle for the cream, which is tapped out into an outer chamber, and thence led off to any desired receptacle through the outlet pipe shown. The top of the rotary cylinder is closed by a bowl-shaped receptacle. On the outer surface of this cylinder a spiral groove is cut. Similarly, but in reverse direction, a groove is cut on the inner surface of the stationary cylinder. Milk is fed from a tank at the right into a trough above the separator cylinders, whence it is led through pipes to the space between the two cylinders near the bottom. The inner cylinder is rotated by a crank through a train of step-up gearing, which gives it a very rapid motion. The effect of this rapid rotation is to drive the cream by centrifugal action up the outer or stationary groove to the cream receptacle at the top, while the skimmed milk moves up the groove on the rotating cylinder and falls into the bowl-shaped receptacle. Two or more radial flanges in the bowl keep the liquid in motion, and assist in forcing the cream up the dome. The skimmed milk passes out of the bowl through small perforations therein, and is tapped out through a pipe at the bottom of the separator. The driving mechanism is inclosed in a box, the lower part of which serves as a reservoir for oil. Into this one of the wheels dips, and distributes the lubricant to the rest of the driving mechanism. The operating crank is connected with the train of gearing through a clutch consisting of a ratchet wheel



IMPROVED CREAM SEPARATOR.

and pawl, so that upon stopping the rotation of the crank, the separator may continue to operate under its own momentum.

The Radium Industry.

Notwithstanding the difficulty in its production (many tons of ore being required to produce 1 gramme), a radium industry has already developed in Germany and France, and although 1 gramme is sold at a little less than $2,000, the manufacturers are said to have orders for several hundred grammes.

The demand for medical purposes exceeds the supply. Radium possesses all the important qualities of the Roentgen rays in addition to the invaluable property of being ready for use at any time and furnishing its rays without the employment of apparatus. It has been demonstrated that a small glass tube, not larger than a goose quill, containing a little more than a thousandth part of a gramme, is as effective as an expensive and complicated electric apparatus for the treatment of cancer—surpassing the best effects of the Roentgen rays.

Automobile Notes.

In accordance with a suggestion from the Automobile Club of America, representatives of all the foreign automobile clubs, in a meeting at Paris, decided in favor of an amendment to rule 9, which will make it possible for drivers other than club members to run machines in the Gordon Bennett cup race of 1904. As a result, it is probable that Barney Oldfield and one or two other American chauffeurs who have made records in this country will pilot our cars, we hope, to victory on the course that has already been selected in Germany in the vicinity of Homburg. The race will probably be run some time between July 5 and 15, 1904.

The Paris automobile show opened with great *éclat* on December 10. It will last till the 23d, and will be followed next month by the New York show, which will last from the 16th till the 25th of January. One of the features of the French show is said to have been a 40-horsepower automobile train in which the power is supplied to all four wheels of each car. The train is said to have run from Paris to Versailles successfully. Another feature of the show was the Martini car in which Capt. Deasy made the ascent of the Rochers de Naye (as detailed in the current SUPPLEMENT) last October. Not only the car, but portions of the cogwheel railway on which the ascent was made, were exhibited. The great increase in electric vehicles was one of the most noticeable things with regard to the show.

SIR OLIVER JOSEPH LODGE, F.R.S.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

"A fine scientist with that rarest of gifts, a power of exposition commensurate with his great learning, and absolutely the kindest man to students who ever sat in an English chair of physics," is the graphic estimate of Sir Oliver Joseph Lodge, F.R.S., by one of his subsidiary co-operators—an estimate that is indorsed by every pupil and *savant* who ever came in contact with him. Prof. Oliver Lodge is now one of the foremost scientists of Great Britain, a pioneer in wireless telegraphy. In fact, it may be safely asserted that the present advanced condition of wireless telegraphy is due in no small measure to Prof. Lodge's numerous investigations and lucid descriptions of the phenomena of the Hertzian waves.

Sir Oliver Lodge was born on June 12, 1851. At fourteen years of age he entered his father's pottery business, where he remained for six or seven years. During this period, hard and incessant work throughout a long day left him but little time for recreation or the improvement of his education. One day he happened to pick up an old monthly number of the English Mechanic, and became deeply interested in its contents. This was his first acquaintance with science, for, as he states, he "never knew there was such a thing as science while at school." Perusal of this stray copy of a popular technical periodical deeply interested him. He continued his studies in a somewhat rhapsodical manner, picking up what bits of knowledge he could from articles in a penny encyclopedia, and attending lectures at the Wedgwood Institute in his native town.

While on a visit to London during his boyhood, he attended some stray classes on geology and other subjects at the King and University colleges, and also six lectures on heat delivered by Prof. Tyndall. The fascination of this subject was so great that young Lodge, as he himself remarks, "realized that he was a born physicist." Every minute of his spare time he devoted to the study of mathematics, physics, and chemistry, and by this means succeeded in matriculating at the University of London with honors in physics. He then studied chemistry under Frankland in the advanced laboratory at South Kensington, and for a session was a pupil of the late Prof. Huxley.

At twenty-one years of age he abandoned his father's successful business and studied mathematics at University College, under Henrici and Prof. W. K. Clifford, and physics under Prof. Carey Foster.

Three years later, in 1875, he took his B.Sc. degree and succeeded to the office of demonstrator of physics at the University, which fell vacant at this time. This year also signalized his first contribution to scientific literature, for he published, in conjunction with Prof. Carey Foster, several papers on the flow of electricity in a plane conductor, in which the forms of the lines of flow and equipotential lines are found practically and mathematically, for various shapes of conductors, and for different positions of the electrodes.

The following year he constructed a model which he exhibited before the British Association for the Advancement of Science. The object of this was to afford a mechanical demonstration of the passage of electricity through metals, electrolytics, and dielectrics, as theorized by Maxwell.

During the next few years Prof. Oliver Lodge was very prominent in the scientific world in connection with electric phenomena. In June, 1877, a paper was issued by him, in which he described a modification of the system advanced by Mance for the measurement of battery resistance. In this method he utilized a condenser for the purpose of supplementing the ordinary Wheatstone's bridge galvanometer, which was generally adopted in connection with this work. This contribution was followed by another valuable suggestion for a standard Voltaic cell. The feature of this latter device was the prevention of contact between the sulphate of copper solutions and the zinc rod. He advocated two ideas by which this end might be achieved. In one the sulphate solution was to be diffused through a long column of sulphate of zinc, and the alternative scheme was to employ a fine capillary layer of the latter substance, by means of which the two liquids might be brought into contact with one another.

Another great work was carried out by Prof. Lodge in conjunction with Prof. Chandler Roberts in 1879. This was in connection with the thermal conductivity of metals and crystals. This was an original branch of research, and has since proved of great value to science. They carried out a series of measurements concerning the resistance of some alloys of copper and tin, in the course of which they discovered the curious behavior.

Dr. Lodge has been intimately connected with the remarkable development of telegraphy during the last twenty-five years, not only concerning its actual progression and improvement, but also the various physical problems closely allied thereto. When the telephone and the Hughes induction balance came into vogue, the question of mutual and self induction came into prominence, and physicists as a whole were closely concerned in investigating this phenomenon. Foremost among these investigators was Sir Oliver Lodge, who advanced our knowledge upon the problem by the publication of a mathematical tneory of intermittent currents and the induction balance. This pamphlet excited widespread attention, for not only did the author therein explain and amplify the facts observed by Hughes; the explanation of the effects produced by making and breaking a circuit; but it was of inestimable benefit to students. Not only was the subject discussed exhaustively, but it was treated in such a comprehensive and lucid manner, that students were able to grasp the action of self and mutual induction in closed circuits.

Sir Oliver Lodge gained his degree of Doctor of Science in 1877. Four years later he succeeded to the Professorship of Physics and Mathematics at the Liverpool University College, which post he retained until 1900. Shortly after his appointment he persuaded the municipal government of that city to establish a large physical laboratory, the construction and equipment of which he personally supervised. The most salient feature of this institution is its democratic character. It is principally intended for the training of mechanics and laborers during the evening after they have finished their daily tasks, so as to perfect them in the knowledge, both theoretical and practical, of their respective trades or the inculcation of another. During the daytime it is utilized for the preparation of students for their various examinations.

As the University under his ægis developed to such an extent, whereby his duties were so increased that he had no time for the prosecution of his scientific researches, a separate chair for mathematics was endowed, and Prof. Lodge simply retained the professorship of physics.

He now carried out a series of experiments concerning the behavior of electric accumulators under a variety of aspects. He devised plates composed of various materials, and also different liquids, the object of which was to determine the combination which yielded the maximum of efficiency. It was during these experiments that he discovered that the sudden failure of, or deficiency in, the E. M. F. of ordinary secondary cells is attributable to the deposit of lead sulphate upon the negative plate.

Prof. Oliver Lodge was the first to measure directly the velocity of the hydrogen ion. This was accomplished in the following manner: A horizontal glass tube was filled with a solution of sodium chloride in solid agar-agar jelly, and this was connected to two vessels containing diluted sulphuric acid. The sodium chloride solution was rendered alkaline with a trace of caustic soda. A little phenol-phthalein was also added, so as to betray any evidence of the hydrogen ion through the tube by discoloration of the solution. An electric current was then transmitted from one vessel to the other. The hydrogen ions from the anode vessel of acid were thus carried along the tube, forming hydrochloric acid during their passage, which decolorized the phenol-phthalein. By this experiment the velocity of the hydrogen ion through a jelly solution under a known potential gradient was observed to be about 0.0026 centimeter per second. The result of this test was to support conclusively the theory which had been advanced some time previously by Kohlrausch.

It is to this eminent electrician that we owe the extension of our environment of knowledge of electric waves, since he has made this phenomenon one of his special studies during recent years, and has considerably added to Hertz's investigations upon the same subject. His experiments with the Leyden jar discharges and waves in conductors are well known. In these experiments he showed that electric pulsations travel over isolated wires with the same velocity as light.

He was also one of the pioneers of wireless telegraphy, and although perhaps he did not devise the first wireless telegraphic apparatus, he rendered communication possible through space without wires to a very appreciable extent by his coherer. He made a close study of the action of electric waves in reducing the resistance of the contact between two metallic surfaces, such as a plate and a point, or two balls, and named this device the coherer. The earliest form of coherer made by Prof. Lodge comprised simply a glass tube a few inches in length containing iron turnings, with contact plates or pins at the end. When this tube is placed in series with a single voltaic cell and a galvanometer, the resistance of the tube is nearly infinite. When an electric spark is created near the tube, the resistance is diminished, and the deflexion of the galvanometer is increased. This deflection of the galvanometer he observed could be used to indicate the arrival of the electric waves, but he found that the tube had to be tapped between each experiment, and the deflexion of the galvanometer returned to approximately its original position.

In 1894 he exhibited at Oxford his first "tapper-back," or automatic system of decohering the iron filings after each impulse. It was this ingenious discovery which has rendered it possible to develop wireless telegraphy to its present advanced stage of perfection. Sir Oliver Lodge, in collaboration with Dr. Alexander Muirhead, has devised a very scientific system of wireless telegraphy, which is now in operation in Great Britain, which was described in the SCIENTIFIC AMERICAN.

In 1898 Sir Oliver Lodge theoretically examined the conductive system of wireless telegraphy. He constructed an experimental system, wherein the primary and secondary circuits were syntonized by the inclusion of condensers in the circuits. Prof. Lodge demonstrated that by syntonizing, the circuits are rendered inductively respondent to each other with a much less power expenditure in the primary circuit than is the case where *no* tuning is adopted.

In 1883-84 Prof. Lodge, in collaboration with the late Mr. J. W. Clark, carried out some very important scientific investigations. Prof. Tyndall some time before had drawn attention to the existence of a dark plane that is always to be observed when dusty air surrounds an illuminated body, and discussed the cause of its existence. Prof. Lodge and Mr. Clark carried out a series of researches upon this curious behavior of dusty air under such conditions, and set forth the results of their efforts in an important paper upon the subject, wherein they set forth the cause for the existence of the dark plane which had attracted Prof. Tyndall's attention. Incidentally they also succeeded in rediscovering the extraordinary effect of electrifying dusty air, which had originally been discovered by M. Guitard some thirty years previously, but had not attracted that widespread attention which it deserved. It had therefore been absolutely forgotten until Lodge and Clark once more brought it under review.

Sir Oliver Lodge, owing to his paramount position in the electrical world, and the many valuable researches which he has carried out in connection with electrical phenomena, has received several decorations from the scientific societies of Great Britain in appreciation of his work in this connection. He is a fellow both of the Royal and Physical societies, and is a Rumford medalist. Owing to his unique electrical knowledge, he has held many important appointments as adviser to special committees, etc. For two years, 1884-6, he was the scientific adviser to the Electrical Power Storage Company. For some time he was secretary of the electrolysis committee of the British Association for the Advancement of Science, during which time he made several important communications to, and translated several foreign discussions upon the subject for the committee. In 1885 he acted as one of the jurors at the International Inventions Exhibition. In 1900 he was appointed principal of the University of Birmingham, a position which he still holds.

His connection with the British Association is of very long standing. He delivered an important lecture upon the subject of "Dust" before this august body at the Montreal meeting in 1884. He was one of the secretaries of Section A of the British Association, and had the honor of opening the first discussion before that section, being on "The Zeal of Electromotive Force in the Voltaic Cell." Owing to his lucid, comprehensive, and expert expounding of the subject on this occasion, he was voted to open a discussion on electrolysis at the next annual congress at Aberdeen. In 1888 he took part in another discussion at the Bath meeting on lightning conductors, and so important and valuable was his communication, that at a later date he published a volume dealing with "Lightning Conductors and Lightning Guards," which is now regarded as a standard work. These electrical guards are of great value for cables, telephones, and electric lighting circuits, and are constructed by Dr. Alexander Muirhead, the collaborator in his recent wireless telegraphic apparatus. In 1891 he was president of Section A of the British Association at the Cardiff meeting. He has delivered many important lectures at the Royal Institution of Great Britain upon a wide range of electrical science, such as the "Deposition of Dust and Fume by Electricity," "The Leyden Jar," and "The Aberration of the Earth through the Ether." The latest theory of his which has excited worldwide attention is that which he recently advanced at Oxford on "Electricity and Matter," which has been fully described in the pages of the SCIENTIFIC AMERICAN SUPPLEMENT.

Prof. Oliver Lodge has a remarkably clear, terse, and comprehensive method of describing his theories and ideas, and he can excite the interest of even the most amateur mind. This trait is of invaluable advantage to him as a lecturer before a class of students, and is much appreciated by them. With the university students he is extremely popular, owing to his untiring energy in assisting them in their studies, and his generous assistance to them in the solution of any difficulties or the explanation of any abstruse problems. By his assistants he is regarded as a friend, owing to his kindness, thoughtfulness, and sympathy.

His contributions to scientific literature are of a very diversified and important nature, while he has compiled many volumes describing difficult subjects in a most popular manner. His most important works comprise "Elementary Mechanics," "Modern Views of Electricity," "Pioneers of Science," "The Work of Hertz and His Successors," "The History of Wireless Telegraphy," and "Signaling Through Space Without Wires." In addition he has also contributed innumerable papers upon various scientific subjects.

Like Sir William Crookes, Sir Oliver Lodge is also a deep student of the occult, and the subject of telepathy, and has written many papers upon the subject for the Psychical Research Society, of the council of which body he is a member.

Correspondence.

The Græco-Etruscan Chariot.

To the Editor of the SCIENTIFIC AMERICAN:

On looking over the illustrations of the Græco-Etruscan chariot, contained in the issue of November 28, I was led to an interpretation of the panels differing from that of Gen. Di Cesnola; and as it appears to fit the case, I should like to make it known through the columns of your valued paper, in which the illustrations of the chariot appear.

Front panel. Before the Greeks sailed from Aulis to attack Troy, Agamemnon was urged to offer as sacrifice his daughter Iphigenia, in order that the gods might send favorable winds. At the place of sacrifice Diana appeared, snatched Iphigenia away in a cloud and left a deer in her stead, which is shown on the panel of the chariot.

The two figures I would take to represent Thetis giving to Achilles his new armor, in order that he might avenge the death of his friend Patroclus, who had just been slain by Hector without the walls of Troy.

The right-hand panel would represent Achilles in the act of slaying Hector, who was wearing at the time Achilles' armor taken from Patroclus:

> No wish
> Have I to live, or to concern myself
> In men's affairs, save this, that Hector first,
> *Pierced by my spear*, shall yield his life, and pay
> The debt of vengeance for Patroclus slain.
> (Bryant's Trans. Homer.)

The left-hand panel would represent Achilles in the act of dragging the body of Hector around the walls of Troy.

The two nude figures might represent the two Trojan maidens Cryseis and Briseis, captured by the Greeks, the latter of whom was the cause of the death of Patroclus indirectly, Achilles having for a while refused to fight.

ARTHUR CHIPPENDALE.

The American Club, City of Mexico, December 6, 1903.

An Artificial Substitute for Pumice.

Artificial pumice is made in quantities in Bietigheim in the valley of the Enz in Germany, which is said to be a valuable substitute for the genuine stone. It is made from ground sandstone and clay, and there are ten kinds, differing from each other in regard to hardness and grain as follows: (1) A hard and a soft kind with coarse grain, particularly useful in the leather, wax-cloth, felt, and wood industries; (2) a hard and soft kind with medium coarse grain, suited to stucco workers and sculptors and particularly useful for polishing wood before it is painted; (3) a soft, fine-grained stone for the white and dry polish of wood and for tin goods; (4) one of medium hardness with fine grain, for giving the wood a surface for an oil polish; (5) a hard, fine-grained one for working metals and stones, especially lithographic stones; and finally pumice stones with a very fine grain. These artificial stones are used in pretty much the same way as those of volcanic origin. For giving a smooth surface to wood, a dry stone is applied, but to give it a fine polish the stone is dipped in oil. For fine work no coarse-grained and for coarse work no fine-grained stones are used. The unreliability of pumice, both in grain and hardness, variations being noted even in the same piece, suggested the idea of replacing it with the artificial product.