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 "tapperback," 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.