TESLA'S NEW LIGHT.

Its Success Largely Due to a New Product of Western Pennsylvania.

A RIVAL OF THE DIAMOND

That Withstands the Terrific Electrical Bombardment.

CARBON CRYSTALLIZED AT LAST.

It Makes a Lamp of Twenty Times the Efficiency Now Reached

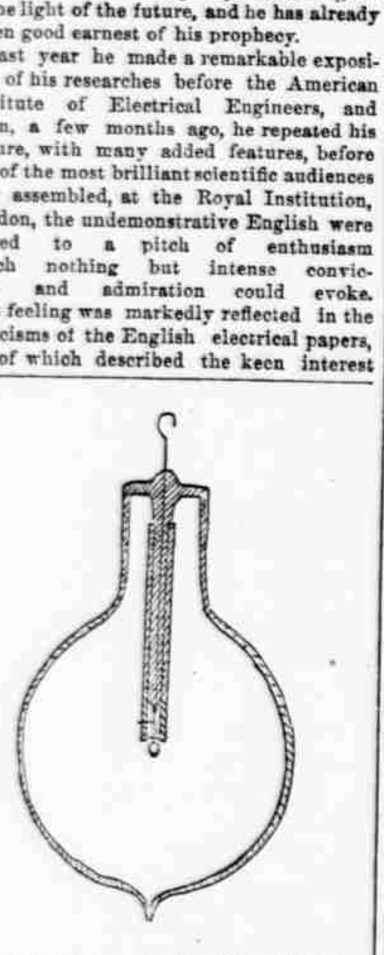
AND REVOLUTIONIZES MANY INDUSTRIES

[WRITTEN FOR THE DISPATCH.]

Dentists' Wheels.

ONE of the prominent figures in the electrical world to-day is Nikola Tesla, whose recent advances into new domains of electrical science have excited the marvel of the world. Tesla holds that a phosphorescent glow is the light of the future, and he has already given good earnest of his prophecy.

Last year he made a remarkable exposition of his researches before the American Institute of Electrical Engineers, and when, a few months ago, he repeated his lecture, with many added features, before one of the most brilliant scientific audiences ever assembled, at the Royal Institution, London, the undemonstrative English were moved to a pitch of enthusiasm which nothing but intense conviction and admiration could evoke. This feeling was markedly reflected in the criticisms of the English electrical papers, one of which described the keen interest



Tesla's New Lamp: Section Showing Button.

"with which Mr. Tesla was watched throughout, as he adjusted his apparatus quivering with lightning-like discharges, and now lighted a vacuum tube by grasping it in his hand, now brought to incandescence the filament of an ordinary lamp attached by a single wire, then rendering the air in the interior of a large ring luminous with flame, or sending streams of light from wires stretched over the audience, and most fascinating of all, after electrifying the whole space of air between his table and an iron plate above him, waving a luminous tube in his hand totally unconnected to any wire whatever.

America Is Just Learning the Truth.

The full text of this lecture has just been received in this country, and the wonders that it unfolds are simply amazing. One cannot help the reflection while reading it that, had Tesla lived a hundred years ago, when the distinction between science and necromacy was not so well appreciated as it is to-day, the warmth with which his views have been received would be of a more material form than that exhibited by his London audiences. He speaks with the utmost confidence of the near approach of the time when lamps and motors will be run not only with one wire, but with no wire at all, and at now incredible distances; there will eventually be no need to transmit power, as there is an inexhaustible store of it, the ability to utilize which will have been developed at every point of the universe.

He maintains that we have as yet but a very slight conception of the possibilities of artificial light production; he believes that at least 20 times the efficiency of our present incandescent lamp can be obtained, and he calmly looks forward to obtaining light effects without the use of any vessel whatsoever, with air at ordinary pressure. To him the distribution of 100,000 volts to any distance within a thousand miles is "an easy matter." He speaks of a system in which the metal pipes are the insulators and the gas in them the conductors, and describes a cable with which telephoning across the Atlantic may become possible, if more advanced modes of transmitting intelligence shall not have rendered it unnecessary.

His Talk Sounds Extravagant.

He speaks in the most matter of fact way of employing currents of a frequency of several millions per second, and takes 100,000 volts through his body without manifesting the slightest inconvenience. But this modern necromancer knows just what he is about and has the strong faith in his opinions which compels success. This is shown by his reply to a London electrician who asked how he came to dare to take such enormous currents through his body, considering that 1,500 to 2,000 volts are regarded as more than sufficient for the purposes of the executioner. He said it was the result of a long debate in his mind. Reason and calculation showed him that such currents should not be dangerous to life any more than the vibrations of light are dangerous. The self-induction and frequency of alternation should be too great for any current to pass, and for a current to be dangerous a certain quantity must pass.

He referred, as an illustration, to a thin diaphragm in a water pipe. With to and fro piston strokes of considerable amplitude the diaphragm will be ruptured at once. With reduced strokes of the same total energy the diaphragm will be less liable to rupture. Thus, said Tesla, it is with vibratory current, and he stretched forth his hand to the electrodes. Even fortified with this seductive logic the man who can thus plunge into dark and unknown depths uncertain whether he will return, must be possessed of qualities which the world is apt to rate at a higher value than mere scientific faith.

A Product of Local Importance.

Such a brilliant record of invention as Tesla's lecture appeals alike to the scientist and the layman, but it has a special interest to the readers of THE DISPATCH, from the fact that it draws attention to the value of a new product, the development of which promises to be of great local importance. One characteristic form of the lamps with which Mr. Tesla illustrated his remarks was a bulb inclosing a button of carbon resting on the end of a wire or a filament. The wire was screened by being surrounded by a tube of aluminum, which forces the radiation to follow it to the button and not stream off sideways. When the single conductor, which this lamp contained, was connected to one terminal of a coil, the carbon glowed with a light the intensity of which varied with the character of the current. Tesla found that a lamp filament cannot withstand the effects of currents of extreme frequency as it does those of steady currents, assuming that it be worked at the same luminous intensity. This means that for rapidly alternating currents the filament should be shorter and thicker.

The molecular bombardment that occurs with currents of high frequency is so severe that Tesla had to go through a long course of experiments in order to discover a button of sufficient stability to stand the strain. He says:

A Wonderful New Material.

Of all the bodies tried there were two which withstood best—diamond and carborundum. These two showed up about equally, but the latter was preferable, for many reasons. As it is more than likely that this body is not generally known, I will venture to call your attention to it. It has been recent-

Effect of Emery and Carborundum on Glass.

ly produced by Mr. E. G. Acheson, of Monongahela City, Pa., U. S. A. It is intended to replace ordinary diamond powder for polishing precious stones, etc., and I have been informed that it accomplishes this object quite successfully. Carborundum can be obtained in two forms—in the form of "crystals" and of powder. The former appear to the naked eye dark colored, but are very brilliant; the latter is of nearly the same color as ordinary diamond powder, but very much finer. When viewed under a microscope the samples of crystal given me did not appear to have any definite form, but rather resembled pieces of broken up egg coal of fine quality. The majority were opaque, but there are some which are transparent and colored. The crystals are a kind of carbon containing some impurities; they are extremely hard and withstand for a long time even an oxygen blast. When the blast is directed against them, they at first form a cake of some compactness, probably in consequence of the fusion of impurities they contain. The mass withstands for a very long time the blast without further fusion; but a slow carrying-off or burning occurs, and finally, a small quantity of a glass-like residue is left, which, I suppose, is melted alumina. When compressed strongly they conduct very well, but not as well as ordinary carbon. The powder, which is obtained from the crystals in some way, is practically non-conducting. It affords a magnificent polishing material for stones.

Like Edison's Search for the Filament.

Having found carborundum, Tesla proceeded to test it with the same tenacity of purpose and hopefulness that Edison brought to bear on his experiments with the bamboo fiber that eventually gave the ideal filament for his incandescent lamp. After various tests with the crystals he turned his attention to the powder, which he made into a thick paint with tar. Through this he passed a lamp filament, rubbing off most of the mixture afterward with a piece of chamois leather. He then held it over a hot plate until the tar evaporated and the coating became firm. This process was repeated until a certain thickness of coating was obtained, and on the point of the coated filament he formed the button in the same manner. He is of opinion that such a button of carborundum, properly prepared under great pressure, will withstand the effect of the bombardment fully as well as anything heretofore known.

The only difficulty is that the binding material gives way, and the carborundum is slowly thrown off after some time. This single objection, however, is likely to be soon overcome. Finding that it did not blacken the globe in the least Tesla suggested its use for coating the filaments of ordinary incandescent lamps, and he thinks it even possible to produce thin threads or sticks of carborundum which will replace the ordinary filaments in an incandescent lamp. He found the carborundum coating more durable than other coatings, not only because the carborundum can withstand high degrees of heat, but also because it seems to unite with the carbon better than any other material yet tried. A coating of zirconia or any other oxide, for instance, is far more quickly destroyed.

Making the Substance Phosphorescent.

Buttons of diamond dust were next prepared in the same way as those of carborundum, which they approached very nearly in the matter of durability; but their binding paste gave way comparatively soon, owing, possibly to the size and irregularity of the grains of the diamonds. Tesla then passes on to the consideration of an important point in the determination of the future utilization of the material of whose possibilities he has formed such a high estimate, its phosphorescing qualities. But, he first asks the question: Can a conductor phosphoresce? What is there in such a body as a metal, for instance, that would deprive it of the quality of phosphorescence, unless it is that property which characterizes it as a conductor? For it is a fact that most of the phosphorescent bodies lose that quality when they are sufficiently heated to become more or less conducting. Then, if a metal be in a large measure, or perhaps entirely, deprived of that property, it should be capable of phosphorescence.

"Therefore," he says, and investigations made subsequent to the expression of the surmise indicate that he was guided by a true prophetic instinct, "it is quite possible that at some extremely high frequency, when behaving practically as a non-conductor, a metal or any other conductor might exhibit the quality of phosphorescence, even though it be entirely incapable of phosphorescing under the impact of a low-frequency discharge."

The Great Secret He Has Uncovered.

In connection with this Tesla offers a passing glimpse of a kaleidoscope, in which the characteristics of alternate currents or electrical impulses make fascinating and bewildering changes and combinations. He says: "By their help we may cause a body to emit more light, while at a certain mean temperature than it would emit if brought to that temperature by a steady supply; and, again, we may bring a body to a point of fusion and cause it to emit less light than when fused by the application of energy in ordinary ways. It all depends on how we supply the energy, and what kind of vibrations we set up. In one case the vibrations are more, in the other less, adapted to affect our sense of vision." One cannot but be struck with the modesty of the distinguished inventor; he speaks of his discoveries as if they were mere matters of passing interest, instead of facts pregnant with a century of progress.

Reverting to the tests for phosphorescence in carborundum, Tesla states that when a single electrode consisting of a metal disc is covered with carborundum crystals, the electrode is covered with an intense film of the whiteness of snow. This was found to be merely an effect of the bright surface of the crystals, for when an aluminum electrode was highly polished it exhibited more or less the same phenomenon.

Tesla's Surmises Prove Correct.

He says his experiments with the samples of crystals obtained were made "principally because it would have been of special interest to find that they are capable of phosphorescence, on account of their being conducting. I could not produce phosphorescence distinctly, but I must remark that a decisive opinion cannot be formed until other experimenters have gone over the same ground."

He speaks with the same degree of reservation of the tests with the powder. He found it would not phosphoresce, but says: "Still the tests with the powder are not conclusive, because powdered carborundum probably does not behave like a phosphorescent sulphide, for example, which could be finely powdered without impairing the phosphorescence, but rather like powdered ruby or diamond; and, therefore, it would be necessary, in order to make a decisive test, to obtain it in a large lump and polish up the surface."

Here again he shows the prescient instinct of the true scientist. As a matter of fact, the phosphorescence of the later forms of carborundum, i. e., those manufactured some months after Tesla's samples, is now beyond question. The discovery of a material which meets the requirements on which such important and far-reaching issues depend is destined to mark an epoch in the history of electric lighting.

The Qualities of Carborundum.

Thus, much of the electrical utilization of the new product to which universal attention has been drawn by the distinction conferred upon it by Tesla's investigation into the nature and qualities of this interesting material lead to the belief that eventually its greatest utilization will be in industries other than electrical. Its later form has the appearance of a greenish-yellow, glistening cindery mass. Under the microscope the crystals are found to be transparent, some are green, others yellow, blue or black, and the refractive power of the whole is so great that the substance is of dazzling beauty. Its general formation is somewhat irregular, more or less resembling bort, or diamond powder, and the facets of its crystals are, as a rule, convex.

Its characteristics are extreme hardness, refractive power, insolubility and infusibility, and especially its high abrasive power. Its manufacture is in such an early stage that it is impossible yet to say where its greatest use will be found. It will unquestionably, however, be in demand by diamond cutters, lapidaries and jewelers, dentists, valvegrinders, and for brass and optical work; in fact in all industries where abraders are used in the form of either diamond powder or emery. The cost of its production is so low that the manufacturing industries will find themselves supplied with an abrasive material of the hardness of diamond powder, and the general adaptability of emery powder, at a price relatively but little higher than that of emery, and practically much less.

It Beats Emery Easily.

A very interesting and conclusive test of its relative abrading power was made before the writer. On the end of one of two strips of glass, about 1 inch wide by 2½ inches long, was placed a quantity of fine emery powder, which had been moistened with water. The second piece of glass was then superposed on the first and at a given signal the two were vigorously rubbed together under pressure for 15 seconds. The emery was then washed off, and a corresponding quantity of carborundum powder of the same degree of fineness was placed on the other end of the glass, and the test was repeated for the same space of time. The difference in the sound of the action of the two powders was at once apparent, the carborundum seeming to have at least twice the grip of the emery. On looking at the record of the respective work on the glass, this impression was more than verified: the emery had made a slight irregular cloudiness on the glass, but the carborundum had rendered it opaque and had cut a well-defined path across it. The cut only hints at the effect produced.

The crystals of carborundum are so hard that it is found impossible to reduce them to a powder by any grinding process, so a crushing force, such as is obtained in a stamping, mill is resorted to. To grade off the powder in the different degrees of fineness, the crushed product is mixed with water and permitted to float for any required length of time, and then run off and allowed to settle in tanks. The coarseness or fineness of the powder is determined by the length of time allowed before running off.

Will Supplant the Emery Wheels.

In this way the grading can be most accurately effected. The time allowed varies from four minutes in the coarse grades to two hours for the exceedingly fine ones. The crude material is made directly into wheels for machine shops. The abrading power of these wheels, judging by tests lately made, will bring them immediately into active competition with emery wheels. One of our prominent manufacturers, in discussing recently the chances of successful rivalry with emery said: "The field is large, Pittsburg alone uses $50,000 of emery wheels yearly, and the annual consumption of these wheels throughout the United States is at least $2,500,000."

The economy of carborundum will be seen in the fact that it will do 25 per cent more work in the same length of time, and the class of labor employed in the use of these wheels is very expensive, running up to $4 a day. The saving, therefore, will be threefold, in labor, time and efficiency. In all probability the finer grades of carborundum will be used with cloth and paper, as emery powder now is. A short time ago some carborundum was submitted to a plate glass manufacturer. Testing the material in his office he decided it was too soft, but he afterward found when trying it in the factory that it was too hard, and for this reason:

Too Hard on Plate Glass.

The finishing process of plate glass is started with sand, and then a coarse grade of emery powder is used. In the course of pressure and abrasion the emery particles break down, and become so reduced as to leave the glass in a high state of finish. The carborundum would not break down, but left the glass finished in a degree represented only by its original fineness, and the conservative glass finisher declined to countenance such a sweeping innovation, even though promised a powder of any degree of fineness he wished.

In the grinding of valves and cocks' the present practice of using a coarse emery powder to begin with causes grooves to be left in the metal, and these have to be taken out by a second process. The actual cost of the emery is a small part of the total expense of the process. A man receiving $3 a day will scarcely use a pound of emery in two weeks. With carborundum this process can be carried out at the first intention, and with an efficiency of 50 per cent in excess of the old process. Beyond this it enables the manufacturer to turn out a class of work, the cost of producing which by the ordinary emery method would be prohibitive.

Equal the Dentist's Diamond Wheels.

One of the most effective uses of carborundum will be in the construction of points for dental engines for the excavation and grinding down of teeth. These points are already made in various sizes, and are commended by dentists with enthusiasm, and declared to be, when properly bound, equal in every respect to diamond wheels. The diamond wheel is a disc of copper charged with diamond powder, and when used it has to be kept continually wet. Another disadvantage is that as the fineness of polish produced on a tooth increases, the effectiveness of the abrading surface decreases, and the expenditure of additional time and labor becomes necessary.

The difference between the ordinary and the carborundum point was shown recently in a dentist's parlor in New York, where the dentist quietly substituted the latter for the former. The patient instantly noticed the change, and described it as the difference between "clean-cutting and jagged-sawing." Most people have had their share of bad quarter-of-an-hours with the dentist, and have a vivid recollection of the sickening vibration of the cutting wheel. It is comforting to know that this form of martyrdom can now be banished. As showing to what extent small units grow into big industries, it may be stated here that there are 25,000 dentists in this country, each of whom uses on an average $10 worth of wheels a year, representing an expenditure of $250,000.

Other Uses of the Wonderful Material.

For the cutting of rock crystals for lenses tests have shown carborundum to be especially effective, and for this purpose it is likely to completely supersede emery, which is now used. A singular characteristic of carborundum is that its abrasive power is increased in proportion to the hardness of the material operated upon. For instance, while in lead plate cutting it would show no higher in efficiency than emery, in treating chilled iron or steel its superiority would be markedly manifest.

Of course, the main interest of carborundum to the scientist will be centered on its newly-found adaptability to the purposes of a wonderful discovery, and more especially will this be the case when crystals large enough to form an entire button are produced, which is easily conceivable. But enough has been said to justify its claim to be considered one of the most remarkable commercial products of recent years, and one which will effect a revolution in a large number of industrial fields.

GEORGE HELI GUY.