Master of the Clothworkers' Company, and the completed buildings were opened on May 11.

At the present time, therefore, the dyeing department of the Yorkshire College is represented by a building of considerable dimensions, and so comprehensive in character and equipment as practically to meet every requirement for the purpose of giving a complete theoretical and practical instruction in the art of dyeing in all its branches.

Some idea of the magnitude of the work done in the dyeing department of Yorkshire College may be gained from the fact that each session over 200,000 dyed patterns are distributed. Each student, according to the time spent in the dyehouse, receives during his course of instruction from 2000 to 20,000 patterns, each of which conveys a definite piece of information on some point connected with the application of this or that colouring matter. Not only is the behaviour in the dyebath of each colouring matter investigated, but notes of the results obtained are made by the students during the progress of the work. Further, each student enters in his own book all the patterns received, together with notes of the materials employed, and the results of each experiment. Hence the students not only learn how to experiment and discover the capabilities of each colouring matter for themselves, but they also acquire the useful habit of observing and of making notes, while their pattern books contain a fund of information which is invaluable to them in their after career. The systematic training which they receive also prepares them to deal with the variable conditions of work in actual practice, such as the character of the water, the nature of the textile material employed and its ultimate uses, and many other points which must always be taken into account in dyeing.

In the practical and pattern dyehouses the students are shown how they are expected to apply in practice the principles they have learned in the course of their experimental work. Moreover, the solution of difficulties which naturally arise under the slightly altered conditions from those obtaining in the experimental dyehouse, the greater confidence inspired by dealing with the larger quantities of material, and the knowledge that the products of their labour are really to be employed in the manufacture of cloth, are all factors of inestimable value in the training of the students before they enter into actual practice, to which they are as it were brought indeed one step nearer by the character of the work pursued. Altogether, the students are able, in the College dyehouses, to gain at least some insight as to the meaning and value of practical experience, and an influence is exerted which reacts by giving life and vigour to the work of the whole department.

The art of dyeing owes much to science, and in a University College like the Yorkshire College, it is not unreasonable to expect that students of the art should, in return, contribute something to science, more particularly to that branch of it which pertains to dyeing. If in the experimental and practical dyehouses the students are taught the *art* of dyeing, in the Clothworkers' Research Laboratory they are also urged to study the *science* of dyeing. The aim here is to assist in the work of gaining a fuller and truer knowledge of the fundamental laws and principles connected with dyestuffs and dyeing, and so help to raise, as far as possible, the whole tone and level of the dyeing trade, by infusing into it the traits of an exact science. The carrying on of original research by advanced students has already become, indeed, a marked feature of the department, and the Clothworkers' Company have, in a special way, recognised the value of such work by establishing a lectureship, the holder of which devotes his whole time to co-operating with the professor in introducing students to this higher form of study.

This research work, too, has an intimate connection with Prof. Hummel's lectures, in the course of which are described the methods employed in preparing the coal-tar colours, in isolating the pure colouring principles of dyewoods, and in studying the chemistry of mordanting, dyeing, &c. By allowing the students to carry out similar experiments themselves, the College enables them to understand, in a clearer manner than is otherwise possible, how our knowledge concerning dyestuffs and dyeing has been acquired, and it is hoped that by reason of the practical experience thus gained in the art of research, some students may, in due time, become independent investigators.

The Clothworkers' Research Laboratory is an addition which gives completeness to the means of instruction in dyeing already furnished. The advanced students are thereby provided with the facilities for extending the boundaries of science connected with dyeing, and it is hoped that many young men will take advantage of the opportunity thus given. If in the pursuit of this object the authorities at Yorkshire College can succeed in attracting and training a band of earnest workers; if a well-recognised and successful School of Research in Dyeing is established, side by side with the School of Practical Dyeing, it cannot but be of inestimable value from an educational as well as from a practical point of view, for, if the students, before they leave the College, are taught to contribute to the general sum of knowledge it it surely education in the truest and best sense of the term.

MR. NIKOLA TESLA'S RECENT ELECTRICAL EXPERIMENTS.

A REMARKABLE paper, by Mr. Nikola Tesla, appears in the June number of the *Century Magazine*. The subject is "The Problem of Increasing Human Energy, with Special Reference to the Harnessing of the Sun's Energy"; and though metaphysical and sociological questions receive a large share of attention, the article contains an account of some very interesting electrical experiments, now described for the first time, illustrated by several very striking photographs, two of which are here reproduced. Mr. Tesla has been engaged for several years in further investigating the properties of alternate currents of high potential and frequency, with which he astonished audiences at the Royal Institution in 1892 (see NATURE, vol. xlv. p. 345). The following abstract of a part of his paper shows that his work has led to results of scientific interest and significance.

Electrical discharges capable of making atmospheric nitrogen combine with oxygen have recently been produced. Experiments made since 1891 showed that the chemical activity

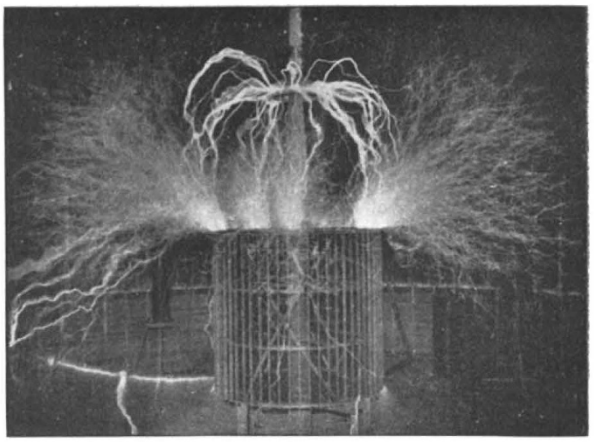

FIG. 1.—Combustion of atmospheric nitrogen by the discharge of an electrical oscillator giving twelve million volts and alternating 100,000 times per second. The flame-like discharge shown in the photograph measured 65 feet across.

of the electrical discharge was very considerably increased by using currents of extremely high frequency or rate of vibration. This was an important improvement, but practical considerations soon set a definite limit to the progress in this direction. Next, the effects of the electrical pressure of the current impulses, of their wave-form and other characteristic features, were investigated. Then the influence of the atmospheric pressure and temperature and of the presence of water and other bodies was studied, and thus the best conditions for causing the most intense chemical action of the discharge and securing the highest efficiency of the process were gradually ascertained. The flame grew larger and larger, and its oxidising action more and more intense. From an insignificant brush-discharge a few inches long it developed into a marvellous electrical phenomenon, a roaring blaze, devouring the nitrogen of the atmosphere and measuring sixty or seventy feet across (Fig. 1). The flame-like discharge visible is produced by the

intense electrical oscillations which pass through the coil shown, and violently agitate the electrified molecules of the air. By this means a strong affinity is created between the two normally indifferent constituents of the atmosphere, and they combine readily, even if no further provision is made for intensifying the chemical action of the discharge.

Under certain conditions the atmosphere, which is normally a high insulator, assumes conducting properties, and so becomes capable of conveying any amount of electrical energy. The discovery of the conducting properties of the air, though unexpected, was only a natural result of experiments in a special field carried on for some years previously. It was during 1889 that certain possibilities, offered by extremely rapid electrical oscillations, led to the design of a number of special machines adapted for their investigation. One of the earliest observations made with these new machines was that electrical oscillations of an extremely high rate act in an extraordinary manner upon the human organism. Thus, for instance, powerful electrical discharges of several hundred thousand volts, which at that time were considered absolutely deadly, could be passed through the body without inconvenience or hurtful consequences. Another observation was that by means of such oscillations light could be produced in a novel and more economical manner, which promised to lead to an ideal system of electric illumination by vacuum-tubes, dispensing with the necessity of renewal of lamps or incandescent filaments, and possibly also with the use of wires in the interior of buildings.

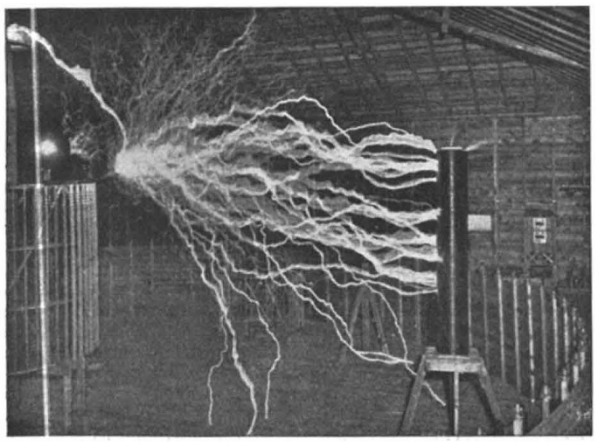

FIG. 2.—The coil, partly shown in the photograph, creates an alternating current of electricity at the rate of 100,000 alternations per second. The discharge escapes with a deafening noise, striking an unconnected coil 22 feet away, and creating such an electrical disturbance that sparks an inch long can be drawn from a water-main at a distance of 300 feet from the laboratory.

The investigations led to other valuable observations and results, one of the more important of which was the demonstration of the practicability of supplying electrical energy through one wire without return. To what a degree the appliances have been perfected since the demonstrations in 1892, when the apparatus was barely capable of lighting one lamp, will appear from the fact that as many as four or five hundred lamps have been lighted in this manner.

The success of this method of transmission suggested that the earth could be used as a conductor, thus dispensing with wires. The earth was regarded as an immense reservoir of electricity, which could be disturbed effectively by a properly designed electrical machine. Accordingly efforts were directed toward perfecting a special apparatus which would be highly effective in creating a disturbance of electricity in the earth, and a novel kind of transformer or induction-coil, particularly suited for this special purpose, was designed. By means of this apparatus, it is practicable, not only to transmit minute amounts of electrical energy for operating delicate electrical devices, but also electrical energy in appreciable quantities.

However extraordinary the results exemplified by Fig. 2 may appear, they are but trifling compared with those which are attainable by apparatus designed on these same principles. Electrical discharges have been produced, the actual path of which, from end to end, was probably more than one hundred feet long; but it would not be difficult to reach lengths one hundred times as great. Electrical movements occurring at the rate of approximately one hundred thousand horse-power have been obtained, but rates of one, five, or ten million horse-power are easily practicable.

The most valuable observation made in the course of these investigations was the extraordinary behaviour of the atmosphere toward electric impulses of excessive electromotive force. The experiments showed that the air at the ordinary pressure became distinctly conducting, and this opened up the wonderful prospect of transmitting large amounts of electrical energy for industrial purposes to great distances without wires, a possibility which, up to that time, was thought of only as a scientific dream. Further investigation revealed the important fact that the conductivity imparted to the air by these electrical impulses of many millions of volts increased very rapidly with the degree of rarefaction, so that air strata at very moderate altitudes, which are easily accessible, offer, to all experimental evidence, a perfect conducting path, better than a copper wire, for currents of this character.

The experiments have indicated that, with two terminals maintained at an elevation of not more than thirty thousand to thirty-five thousand feet above sea-level, and with an electrical pressure of fifteen to twenty million volts, the energy of thousands of horse-power can be transmitted over distances which may be hundreds and, if necessary, thousands of miles. Investigations are now being carried on with the object of reducing considerably the height of the terminals now required.

SOME SCIENTIFIC ASPECTS OF TRADE.

A REPORT on the trade and commerce of Leghorn, for the year 1899, by Mr. Vice-Consul Carmichael, has just been received at the Foreign Office and published as No. 2714 of the Annual Series. The following extracts from the report are of interest as showing the various points at which scientific work and knowledge touch industry.

The proportion of sulphate of copper imported from Great Britain in 1898 was 96 per cent.; it had in 1899 fallen to 76 per cent. The explanation of this unwelcome fact appears to be due to keen United States competition. Italian manufacture is likely to become an even more formidable danger in the near future. Manufacturers appear as a rule to have gone to England for the greater part of the raw material, and that of itself was a handicap. Now, however, the flourishing and influential Società Metallurgica of Leghorn is busily erecting the necessary plant for the manufacture of sulphate of copper on a large scale. Italy produces some 26,000 tons of copper annually, and it is said that the company can depend upon securing its material at home. Should this be the case it will at once be seen how formidable a competitor is entering the field. In any case the more satisfactory days of the English trade in sulphate seem to be over.

As this series of reports is yearly obtaining a larger circulation it may perhaps be necessary to state that the wood from which briar pipes are made is not the root of the briar rose, but the root of the large heath known in botany as the *Erica arborea*. Our "briar" is but a corruption of the French "bruyère." The briar-root industry has had a somewhat curious history. First begun in the Pyrenees some 50 years ago, it travelled along the French Riviera and the Ligurian coast (taking Corsica by the way) to the Tuscan Maremma, and has now reached Calabria in the south, which is at present its most flourishing centre. By the very nature of the business, when a certain district has been exhausted of all its roots, the industry must come to an end there, and I have heard the opinion expressed that the Italian branch of it cannot last much more than another ten years. Leghorn has always been the centre of the export of Tuscan briar-root since the Maremma industry came into existence, but as the South Italian briar is of admittedly superior quality, a large quantity of the Calabrian root is also imported into Leghorn for selection and subsequent export.

The olive oil crop throughout Tuscany, small as it promised to be, has, I regret to say, been more than half destroyed by