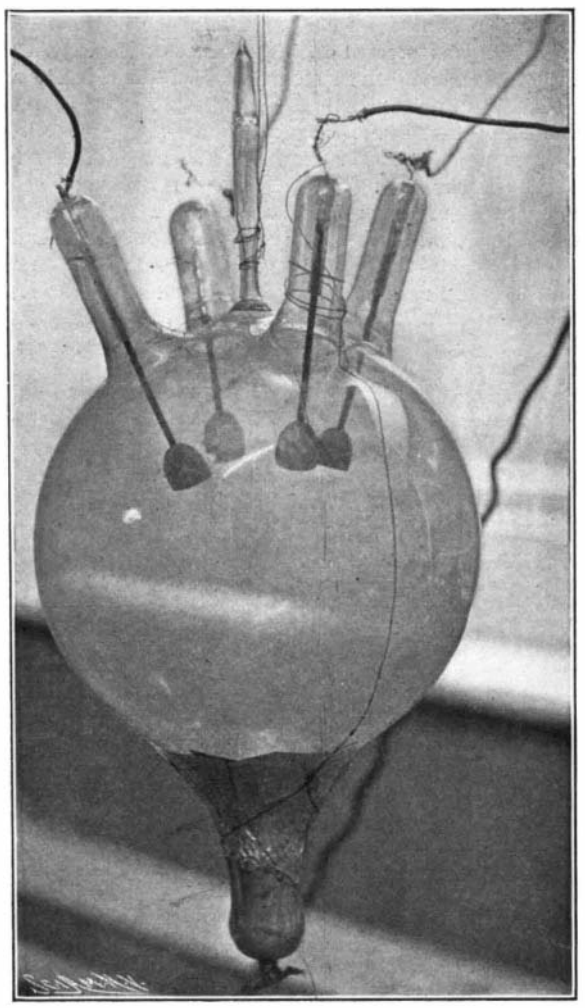
THE COOPER HEWITT LAMP AND STATIC CONVERTER.

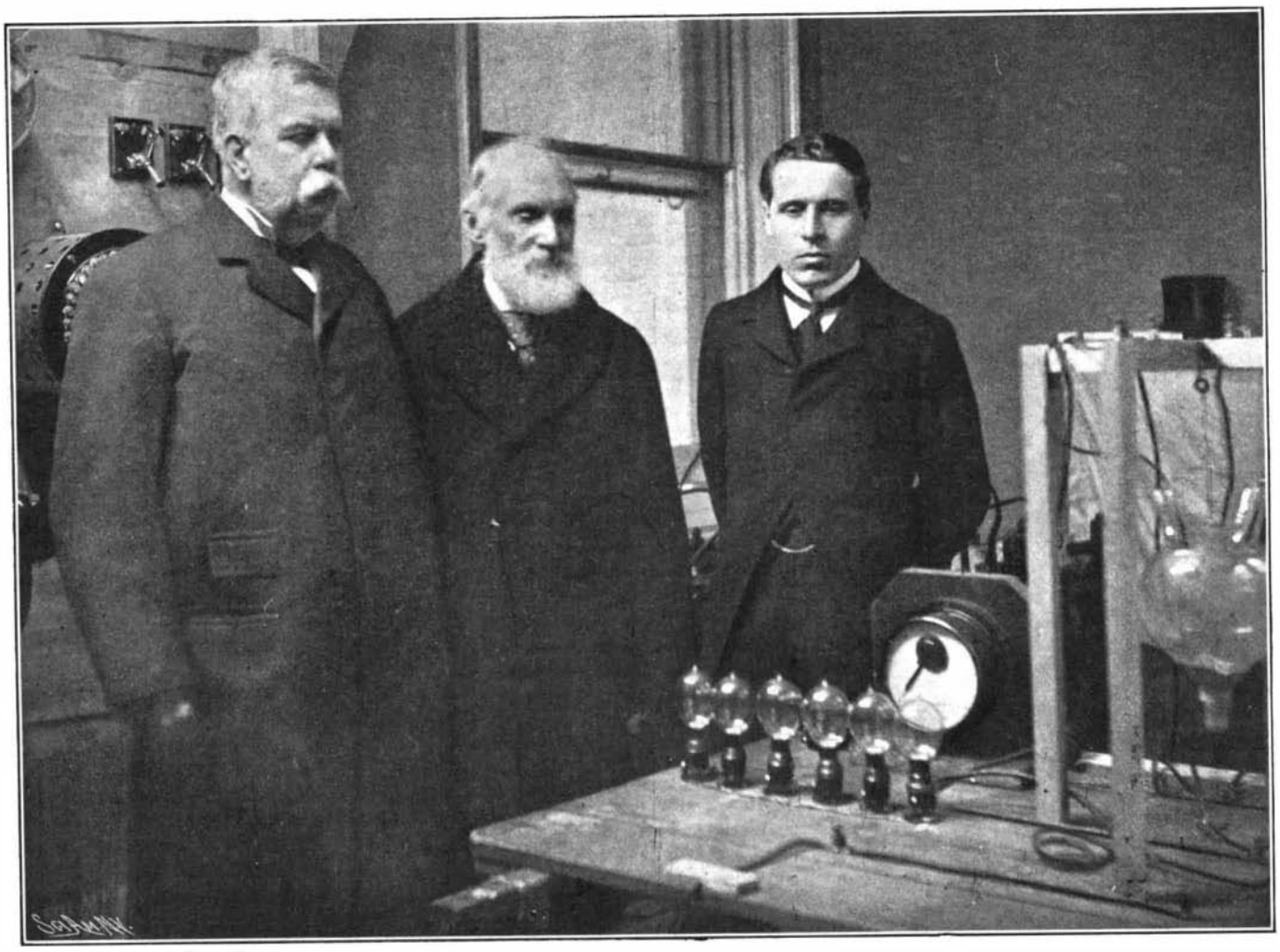
Great interest attaches to the exhibit by Mr. George Westinghouse, during his recent stay in London, of the new lamp and converter invented by Mr. Peter Cooper Hewitt. The lamp was shown in its commercial form to Lord Kelvin and a number of other prominent men, and the curious "static converter" was there, for the first time, brought before the public. About two years ago the Cooper Hewitt lamp was shown as a laboratory apparatus at a "Conversazione" at Columbia University, and was described at that time in the SCIENTIFIC AMERICAN.

The lamp in its present form consists of a glass tube of any desired shape with a bulb at one end which contains a small quantity of mercury. All air is exhausted from the tube, which thereupon fills with vapor from the mercury in the bulb. Electrodes are provided at each end of the lamp, the negative electrode in the bulb of mercury and the positive electrode at the opposite end. On passing a direct current through the lamp, the vapor which fills the tube is rendered incandescent and gives off a steady, blue-white light. Owing to the great resistance at the negative electrode to the initial flow of current, it is necessary to use a high voltage to start the lamp. This is commonly done by passing a spark from a "choking" coil through the negative electrode, which when once penetrated offers but slight resistance to the flow of current. If for any reason the current is interrupted, the high resistance is immediately resumed and must be broken down again before permitting further flow of current.

The light given off by the incandescent vapor is entirely lacking in red rays, and this has its advantages to the eyes, for, as is generally known, red rays are the most injurious to the eyesight. However, owing to this peculiarity of the light, some very extraordinary color deceptions are produced. Different shades of red reflect only the colors with which they are mixed, assuming colors varying from a dirty brown to a bright violet. In Mr. Hewitt's laboratory, where three of these lamps are used, a soft, well-diffused light is produced. Laboratory attendants affirm that they prefer to work under this light than with ordinary daylight, and have become so accustomed to the absence of red rays that they can, to a large extent, discern the true color of any object brought into the room. To the uninitiated, however, the appearance of the room is startling, indeed. One is at once struck with the green appearance of all woodwork, and then with the green and purple blotched faces of the draftsmen. A question which Mr. Hewitt usually has to answer when exhibiting these peculiar color deceptions is, "Why don't you put a red globe around your lamp and thus get red rays?" This is apparently an easy solution of the difficulty until one is reminded that red glass does not change light waves, but simply suppresses all the rays that are not red. Since there are no red rays in the Cooper Hewitt lamp, the effect of the red globe would be to cut off all the light. It has been Mr. Hewitt's aim, therefore, to discover some material which would act as a transformer to change some of the waves of light into red waves. In this search he has met with considerable success, finding that silk dyed in rhodamin gives very satisfactory results, the only objection being that the power of the light is somewhat reduced on using this transformer. A simpler method of rectifying the deficiencies of this lamp is to blend its light with an equal power of the ordinary electric light. This combination also results in great economy of current because the Cooper Hewitt lamp is probably the cheapest artificial light in the world. The mercury vapor lamp consumes one-half watt per candle power as against 3½ watts in the incandescent lamp. Thus if the two lights are combined in equal quantities, the resulting light would require only two watts per candle, a saving of 1½ watts per candle over the ordinary incandescent lamp. On account of its wonderfully low cost, the Cooper Hewitt light should be found very useful, without the addition of any rectifying light, for illuminating factories, yards, etc., where the differentiating of colors is unimportant. Another promising field for the new light is that of photography. Being rich in actinic rays which most affect the photographic plate, the mercury vapor lamp is found to give excellent results. It has been in commercial use for purposes of photography for some months, and its practical value has been thoroughly tested. One of our illustrations is a reproduction of a photograph of Mr. Hewitt and Lord Kelvin taken under this mercury vapor light.



THE COOPER HEWITT STATIC CONVERTER.



Mr. George Westinghouse. Lord Kelvin. Mr. Charles Merz.

WATCHING A TEST OF THE COOPER HEWITT CONVERTER.

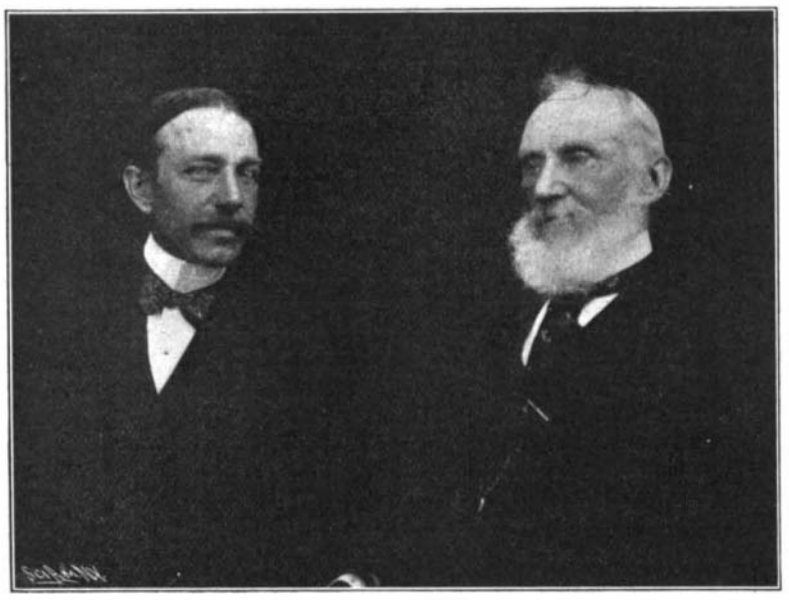
In the course of his experiments on the mercury vapor lamp, Mr. Hewitt discovered his "static converter," to which we have referred in a previous issue. This converter, or arrester, as it might more properly be called, acts to check the negative waves of an alternating current, permitting the passage of the waves in the positive direction only. The apparatus is similar in every respect to the lamp except that several positive electrodes are provided, one for each winding of the motor and another for the starting device. The lamp is also made spherical, so as to provide a larger area for dissipating the heat in the apparatus, and at the same time to reduce the distance between the positive and negative electrodes, with consequent reduction in the waste of current. Our diagrams illustrate the connections with a Y-wound three-phase circuit. As in the case of the lamp, the resistance of the negative electrode must first be broken down before a current will flow. This may be done by connecting the converter with a circuit containing a "choking" or "kicking" coil, and causing a spark to jump between the electrode *a* and the negative electrode *e*. This breaks down the resistance of the latter electrode, and permits current to flow therein from electrodes *b*, *c*, and *d*. No current can flow back into any one of the positive electrodes when it becomes negative to the others, because its resistance has not been broken down. Thus it is that a path is provided for the current in positive direction only, while the circuit for the negative flow is open. The extent to which the negative electrode resists the flow of current, and the amount by which it is reduced while a current is passing, will be readily comprehended when we remember that the difference of potential between any two of the upper electrodes is at times far greater than between them and the electrode *e*. A two-phase or single-phase current could not flow through the converter, because in these currents there are periods when no positive current is flowing, which would permit the high resistance at the electrode *e* to be resumed, stopping the flow entirely. With a current of three or more phases no such negative periods exist, and a constant flow is assured. The negative portion of the wave may be ignored or, if desired, it may be used on another circuit. In either case no power is lost. The current as it flows from electrode *e* is of a pulsating character, though flowing in one direction only. The circuit is completed to the neutral point of the Y-winding. We have illustrated this circuit as containing a storage battery, a number of incandescent lamps, a direct-current motor, and several arc lamps.

During the operation of the converter the mercury of the negative electrode is in constant motion, due to the pulsating character of the current. The mercury vapor as it rises in the globe is condensed on the glass, and trickles down the side of the vessel back to the mercury reservoir. In this way the mercury which is vaporized is constantly being replaced by the condensed metal. It is on account of this action that mercury is used instead of some other substance. Mercury is an elementary substance, and having scarcely any effect on iron, which is used for the positive electrodes, forms no objectionable chemical compounds, such as might occur with some other substances. An interesting feature of Mr. Hewitt's converter is the fact that the loss due to a passage of current through the lamp is constant at 14 volts. Thus with a current at 140 volts there will be a 10 per cent loss, while at 1,000 volts the loss would be only 1.4 per cent. From this it follows that the greater the voltage the smaller the globe necessary to dissipate the heat produced.

The advantages of this apparatus are of the most revolution-

ary character. The expensive and bulky rotary converters of to-day would be displaced by these simple globes, and the operating expenses of our substations would be cut down to a very trifling sum. Many other uses will at once suggest themselves to our readers, all of which would be too numerous to mention here.

Mr. Hewitt has obtained fifteen patents covering the principles involved in his system of lighting, and has entered into an agreement with Mr. George Westinghouse for the sale of all his patents to the Cooper Hewitt Electric Company. The company has control of both the lamp and converter. A factory is being installed in New York for the manufacture of these lamps and converters, and it is expected that the lamps will be placed upon the market during the coming summer.



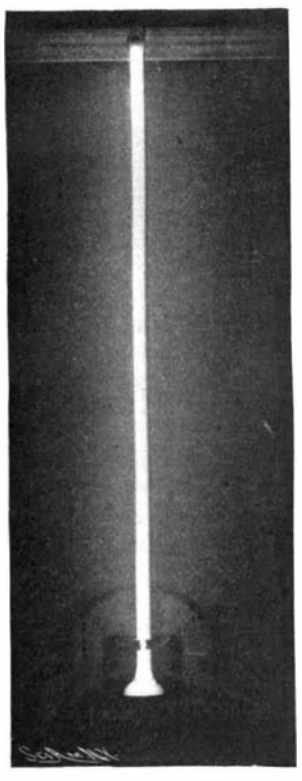
MR. PETER COOPER HEWITT AND LORD KELVIN. A PHOTOGRAPH TAKEN BY THE COOPER HEWITT LAMP.

Natural Gas in England.

BY WILLIAM EDWARD WARD.

At a tiny village in Sussex, less than fifty miles from London, a field of natural gas has been struck which in area and yield promises to be greater than any single American field.

The history of this discovery is a curious commentary on English conservatism. More than a quarter of a century ago, foul air, in a boring sunk by a geological survey, caused an explosion; but the hint passed unheeded. Six years ago need for water was felt at the tiny railroad station of Heathfield, and the company sank a well in search of it. A smell of gas was noticed as the boring was being sunk, but it was vaguely ascribed to "foul air;" until someone applied a match to the borehole, with the result of a burst of flame which was with difficulty extinguished. At a depth of 380 feet the attempt for water was abandoned, but a heavy pressure of gas came from the hole, and this has been constantly used since by the railroad company to light the station. The "marsh gas lamps" proved a source of wonder to the neighborhood, and about twelve months ago local gossip attracted American notice to the curiosity. As the result of intelligent investigation, capital was interested and a company was formed.



THE COOPER HEWITT MERCURY VAPOR LAMP.

At present this company is busily boring day and night, using light and power supplied by gas already tapped; and in the meantime it is reaching out after options and contracts. The possibilities of the field are vast, and the company hopes to control the supply and furnish light and power to the whole of central and southern England. The company has already sunk one well to a depth of 400 feet, and other borings are in progress. At this depth gas is struck at a pressure of 200 pounds to the square inch. As the pressure in the borings steadily increases with the depth, it is probable that a still greater pressure will be obtainable if necessary, though the present one of 200 pounds is sufficient to carry the gas to any large city in England. The capacity of this initial boring is estimated at about fifteen million cubic feet per day; and ten such borings would supply the total requirements of London. An additional ten would suffice for the needs of all the towns on the two principal south of England railroads—both of which traverse the field. The syndicate controlling the field believe that the yield of the first well will prove an average one, and that borings may be increased indefinitely. They are looking forward to a big future.

The investigation of the gas fields by the practical method of boring has been confined to a narrow limit; but the geological indications point to a wide productive area. The strata in which gas occurs are a series of shale beds known locally as Kimmeridge clays, and these underlie a very considerable area in East Sussex. The local theory is that these deep-seated shales are saturated with liquid petroleum, which passes into gas under the pressure-easing advent of a borehole.

Analysis shows the gas to be singularly free from the impurities, such as ammonia and sulphureted hydrogen, which are present in some American yields, It contains 75.5 per cent of marsh gas, 18 per cent of oxygen, 4 per cent of carbon monoxide, and 5.5 per cent of higher hydrocarbons. In this the percentage of higher hydrocarbons is higher than in American gas; with the very practical result that it may be burnt without enrichment, for illumination. As it issues from the well it gives a light only slightly inferior to the not very high standard adopted by the large London gas companies. Used with incandescent mantles it gives a light superior, unit for unit, to coal gas under the same conditions. It has been applied to gas engines with a saving of almost 50 per cent as compared with coal gas, and the change is effected without any adaptation or even special cleaning of the machinery.

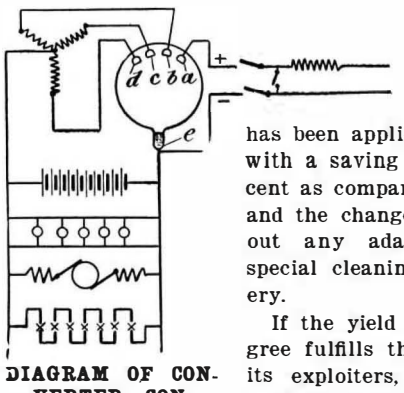
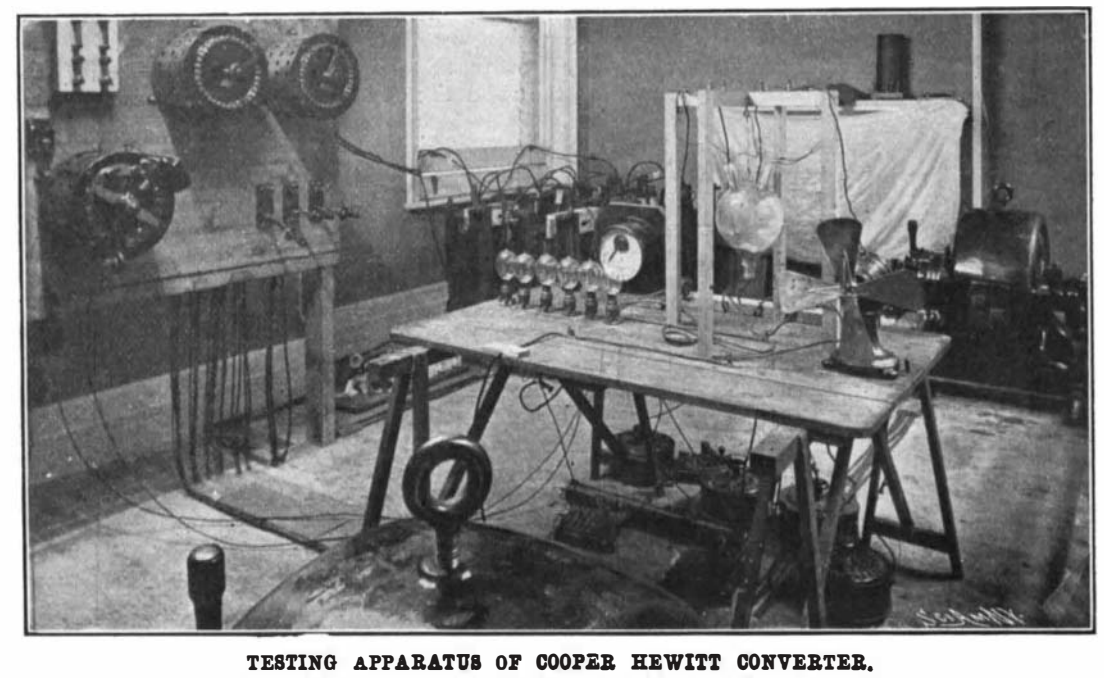


DIAGRAM OF CONVERTER CONNECTIONS.

If the yield of gas in any degree fulfills the expectations of its exploiters, it will soon be available for extensive industrial application. Already the Englishman is beginning to wonder whether natural gas spells pictorial ruin to one of his choicest sylvan counties. Sand of a quality adapted for high-grade glass-making is found in the district; and the first boring pierced a bed of ironstone which in earlier and more primitive days was extensively worked in the neighborhood. But Sussex is not remarkable for its transport facilities, and the ease with which gas can be carried along a pipe-line, together with the fact that factories already exist in other parts of England, will probably result in the supply being carried away to already established centers of industry.

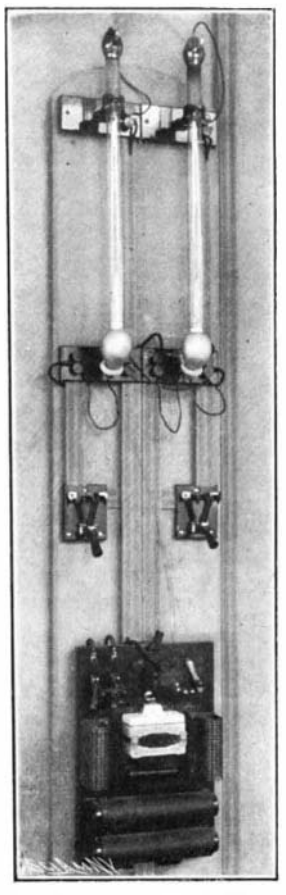
The sentimental aspect of the question is sufficiently strong to bear practical result. Instead of dotting the ground with storage tanks, the company are sinking them underground. A well some 75 feet deep and 15 feet in diameter is sunk, and lined with boiler plates calculated to withstand a high pressure. From the tank thus formed a bore-hole descends to the gas-yielding strata, and from the top of the tank an underground main conducts the gas away. More fortunate even than the much-envied coal lords, the Sussex landowners are looking forward to fat royalties from enterprises so hidden away that they will not permanently disfigure a single foot of ground, nor injure a single head of game.



TESTING APPARATUS OF COOPER HEWITT CONVERTER.

Electrolytic Reduction of Nitric Acid.

In Zeitschr. Anorg. Chem., J. Tafel describes an investigation of the alterations which nitric acid will undergo by electrolysis in the neighborhood of the kathode, considerable amounts of sulphuric or hydrochloric acid being present. A reduction will occur with most kathodes, excepting, for instance, platinum. The mean products of this process are ammonia and hydroxylamine, their ratio depending on a whole series of factors, and varying to a high degree, according to the nature of the kathode, whereas the sulphuric and hydrochloric acids do not seem to exhibit any marked differences. The largest amounts of hydroxylamine are evolved with pure mercury kathodes, or well amalgamated electrodes, the formation of ammonia being almost wholly prevented in some cases, so as to obtain a nearly perfect quantitative transformation of nitric acid into hydroxylamine salt, whereas, in the case of lead kathodes, the amount of the acid transformed into hydroxylamine was not higher than 40 per cent, for copper 15 per cent at the most. The rate of this reduction is smallest in the case of copper electrodes. It is next shown that, with electrodes giving rise to this reduction process, hydroxylamine sulphate will equally be reduced, and *vice versa*. From these facts it is argued that the electrolytic reduction of nitric acid to ammonia at copper kathodes does not pass through hydroxylamine. In order to account for these phenomena, an hypothesis analogous to Chilesotti's interpretation of the effect of the different kathodes on the reduction of nitrobenzol is suggested, certain materials, as, for instance, copper, transforming the reduction process leading from nitric acid to hydroxylamine, by a chemical action, from its essentially electrolytic nature, so as to produce ammonia directly. These experiments tend to show the existence of a specifically electrolytic reduction effect with a given kathode and a given electrode, this effect being in some cases not only quantitatively, but qualitatively, different from the corresponding chemical effect.



MERCURY VAPOR LAMPS AND STARTING COILS.

Last spring Gov. Odell of New York appointed a commission to inquire into the necessity for establishing a State Electrical Laboratory in connection with the Union College of Schenectady. The commission has completed its report, and recommends an appropriation of $275,000 for buildings and electrical equipments. The laboratory is to supply information on questions of electrical science, and an official standard for electrical measuring instruments and apparatus, together with standards for electric wiring of buildings for the protection of municipalities and the general public. Such a laboratory has been established in Germany and has proven a success.