THE STEAM ENGINE INDICATOR.

By "Pupil."

ON Wednesday evening, Jan. 23rd, under the auspices of the stationary and marine engineers, Prof. Galbraith, of the Practic School of Science, delivered a lecture in Shaftesbury Hall, Toronto, on "The Steam Engine Indicator." The lecturer provided himself with crayon sketches of many of the indicators, beginning with the Watt Indicator, the first made, in the year 1814. This indicator, as described, did not in any way represent the travel of the piston, but simply recorded the amount of vacuum in the engine cylinder, and was only of use when the pressure was at or below the atmosphere. Watt's second indicator had a motion to represent the piston movement of the engine by means of a sliding board. This indicator would record the steam pressure above the atmosphere as well as the inches of vacuum in the cylinder, and was the first known attempt to represent the movement of the engine piston.

The McKnaught Indicator was then taken up as the next development of the instrument, and the necessities for the changes, as the speed of the engines was increased, clearly shown. The Richards Indicator followed next, showing a still more perfect machine, with its short spring and light pencil motion. The Thompson, Crosby, Tabor, Darke, Kenyon, Casestilli, were each described in term. These explanations were made very lucid by reference to the crayon sketches. The lecturer explained the use of the plamometer as used for measuring up the indicator diagrams, and by the use of the black-board showed a diagram, and explained the meaning of the lines—showing the point of admission and the admission line, the point of cut-off and the expansion line ; the point of release and the exhaust line ; the point of compression and the compression line ; after which he showed clearly that the better one understands the engine he is indicating, the more is to be learned from the diagram. This was done by means of a sketch of one taken from the air pump of a flooded condenser, which really had the appearance of a diagram taken from a good working slide valve engine.

The lecturer took up the matter of producing defective diagrams, and the general causes for the same. Among the many reasons given for poor diagrams, was badly lubricated instruments, connecting pipes too small and too long. This was illustrated at some length by black-board illustrations of diagrams taken by the same indicator, on the same cylinder, and with the same pipes. In this case the indicator was placed near or at one end of a long cylinder, and piped from the other end. In taking the diagrams, one end represented over double the work that the other did, and as everything about the engine showed that the work was evenly distributed, the experts, who were very eminent English engineers, determined to hunt up the cause. The long pipe was covered with waste, but this made no difference. It was then jacketted with live steam from the boilers, when the diagram from that end of the cylinder showed nearly or exactly like the one from the end at which the indicator was placed.

The lecturer took up the various reducing motions for driving the drums of indicators, going fully into the principles of the pantograph and the pendulum motion. These were explained on the blackboard by means of chalk diagrams. He next gave a description of the trouble experienced in getting this machine, (especially when applied to modern high speed engines) to work smoothly, showing the difficulty caused by spring vibrations, such as wavy or serrated expansion lines. The points made in this connection were, that if you strike a spiral spring on end it will make just so many vibrations per second, and it will make no difference whether you strike it hard or easy, the number of vibrations will be the same. Each spring has its own number of vibrations. The heavier or stiffer springs make the most vibrations in a given time, consequently the vibrations must be shorter. In following up this line, it would be seen that if a very light spring was used in the indicator running at a very high speed ; these vibrations might be represented by only 1 the expansion curve, which would distort the diagram until it would be useless. If these vibrations are made as many as possible, they would be so short that they would not make a visible effect on the shape of the diagram.

The waste of heat in connection with the steam engine cylinder was touched upon, and it was shown how it would be possible to detect this without the use of the indicator. This waste, and the work done in the cylinder, was illustrated by colored crayon diagrams, two of which were shown from the same engine, one representing the action at 20 h. p. and the other at 6 h. p. The difference was clearly shown, and was of a surprising character. First, the regular indicated diagram was shown in black ; then the heat wasted was represented by a red diagram ; and the heat utilized or converted into work by blue. These were all drawn to a scale in such a way as to illustrate the action to the eye. The lecturer explained the cooling and re-heating of the inner walls of the cylinder and piston, as they are subject alternately to the heat in the steam at atmospheric pressure or less, and the heat due to the initial pressure of the stroke, showing that before the steam does any work in pushing the piston, it must reheat this metal. So much of the lecture was illustrated by crayon drawings that this account of it cannot convey to your readers the sound knowledge and talent displayed by the lecturer. His audience were pleased to sit and listen to him for two hours, and at the close of his remarks he was tendered a hearty vote of thanks. The audience was composed of engineers and machinists, about 125 in number.

On the 13th Feb., Professor Ellis will lecture in the same place, under the auspices of the same societies, on "Combustion and its Gases." This will be a very interesting lecture, and as it is free, it is hoped there will be a large attendance of mechanics looking for knowledge.

DEVELOPMENT OF ELECTRICITY.

THE year just closed has been one of immense strides in all matters of interest to the electrical community, which, by the way, will, if present indications be correct, soon mean the whole civilized world, says a writer in the *Times*. Few looking at the ele trical appliances already in use and those about drawing to perfection would imagine that the modern development of electricity which has brought it into commercial use throughout the world is included within so limited a period as a dozen years. The patents on incandescent lighting hardly go back that far, yet to-day we find 3,000,000 lamps in use in the United States and contracts already made and partially executed that swell the number to almost double that amount. The contrast with the condition of commercial electricity of only a year ago, strikes one with amazement, not surpassed indeed by the feeling of astonishment, with which at the beginning of the civil war, we heard a bell ring in one room when a door or window in some other apartment was opened. The tendency with electrical interests, like all others in which large amounts of capital are involved, is toward centralization, and if the current reports, from what are generally deemed authentic sources, can be believed, there are st ll more important combinations about to be consummated, in which a very large amount of foreign capital is to be introduced, so that the ligh ing, motor and manufacturing interests of several combinations will in the future come under one management. No more substantial proof than this willingness to invest large amounts in electrical interests could be placed before the public, showing as it does how firm a foothold electricity has obtained as good, substantial property for investment.

The two all-absorbing questions on which electricians are already taking decided stands are the lternating and the continuous currents, the possibilities and advantages of each, and there can be but very little doubt that the fight between the two will wax hotter and hotter, especially when instalments are more general than at present and competition more keenly felt. Now, if a company loses one contract it is sure of finding several in other places, and there is not that great necessity for stopping by the wayside to dispute about particular points. What the people in general desire is electric motors, and they care very little for the special features of the system as long as their safety is not interfered with by tracks as conductor, and there are no overhead wires to mar the beauty of their city. For some years the public has waited more or less patiently for the coming motor that was to be less expensive than horseflesh, and far less a nuisance than the smoky, cinder-throwing, dripping engines of our elevated system, and the success attained by the Daft motor Ben Franklin on the elevated road, with cars run by the Julien storage battery system on the Fourth avenue surface line go really further toward convincing Gothamites that there really is a prospect of their condition being bettered than any amount of written promises of still better things to come could possibly do. If 1889 will show as much improvement in traction motors as 1888 has done we may be sure that what we at present deem a wonderful change for the better will sink into utter insignificance in comparison with what we shall then be enjoying.

A storage battery that will combine endurance and power with lightness and economy is what all are in search of at present, and so urgent a demand must produce the desired commodity in a very short time. We recently have heard of an omnibus in England, run through a crowded thoroughfare by electric motor alone, and guided the whole distance without accident or collision of any kind, being run on the pavement without tracks—perhaps not a particular performance in itself, but another point scored in favor of electrical improvements. All of these features tend towards giving us confidence in the opinion that the deficiencies which at present seriously interfere with the usefulness of the storage battery will be remedied in the near future, and that our railways will be propelled in utter disregard of ice or snow as well as all interferences which keep other systems from being quite acceptable to those who are forced to travel through the crowded streets of our metropolis. The storage battery also finds a large field for its usefulness in the lighting of houses in country towns or at a distance from any lighting station, and this promises to develop very largely the additional departments that some of the larger companies have already given considerable space to. Much has been accomplished by the instalments in the mining districts of the western portion of the United States, and the attention that the companies are bestowing in that direction bids fair to result in the supplanting of all other methods of raising and transporting material from the mines, as well as working all other machinery in connection therewith.

The discussion of improvement in matters of electrical appliances would hardly be complete without reference to the development of the writing telegraph, which promises so very much that is wonderful and useful, and which, if such promises are fully carried out, will in the course of a twelvemonth, add immensely to the ease and convenience of communication between individuals. The application of electricity to matters on shipboard has received the attention it deserves, but our marine is perhaps so far behind the rapid development of matters on shore that it will at present have to stand until the more important matters have due attention. The important first step is, however, being taken as far as naval vessels are concerned, one of our steel cruisers is to be fitted with an appliance for hoisting shell and ammunition for the use of the larger guns of her battery, and as fast as other vessels are ready they too will have some similar fittings, depending however, upon the success of those at present being introduced. The government having taken the lead and the experiment proving a success, the ship owners will not be slow in following, as efficiency can only be maintained by adopting that which is most satisfactory in the mechanical development of the day. As a very interesting writer on electricity states it : "Electricity is aggressive, and is pushing itself into many new fields. The next few years bid fair to witness new practical developments, and no wise man would venture to lay bounds to the extent to which electricity will enter into the civilization of the next decade."

UTILIZING DISTANT POWER.

HOW to utilize power some distance away from the works of a factory where it is wanted, is becoming a problem of much interest to mill men generally. This is being tried in several places, says the Boston *Commercial Bulletin*, and it is reported with general success. That in Holyoke is now so far along, that the prospects have been issued by the power and light company owning this power stating at what prices light and power will be furnished. The same idea is contemplated by Haverhill parties, and now a syndicate or company have another location in view. It seems that this party is now erecting a set of three mills in the vicinity of Minneapolis. Upon the Mississippi, about two miles below this point is a water-power which this company have bought. What they propose to do is to set up a private power station at this water point, put in three dynamos, and wire the electricity generated to the motors in their mills. The dynamos will be of 105 horse-power each. The extra five horse-power is for the loss in transmission. It is estimated that about two and one-half horse-power will be the maximum loss, as the best of copper wire will be used, but it has been thought best to have a surplus of spare power. The dynamo and apparatus will be furnished by the Eddy people.

The area of the steam piston, multiplied by the steam pressure, gives the total amount of pressure exerted. The area of the water piston, multiplied by the pressure of water per square inch, gives the resistance. A margin must be made between the power and the resistance to move the pistons at the required speed.

An English electrician has invented a material, which he calls alterion, for the prevention of corrosion in boilers. The interior is coated with this, and currents of electricity are passed through the boiler and from time to time reversed. The formation of the scale is prevented by a layer of hydrogen gas, which is deposited upon the inner surface of the boiler. The reversed currents reform the hydrogen into pure water, a thin layer of pure water being thus kept all around the boiler.