condensed, stated two things. First of all, he said, in substance, at all events, that it was dangerous to transmit electricity at a high tension, and it was very difficult to get a uniform light. The other speakers had dealt with the financial part of the question; he had paid particular attention to the remarks of one or two speakers in connection with the point he had mentioned. Our friend, Mr. Fitzmaurice, had had very considerable experience of electricity, and he thought from the remarks made by him and by Mr. Cracknell that they were decidedly of opinion that electricity of a high tension was very dangerous. Now, on the other hand, Mr. Fischer and Mr. Selfe, and various others quoted from some most eminent authorities to show that electricity of a high tension was perfectly safe. Here we had two very antagonistic opinions. So far as our colonial electricians were concerned, they seemed to him to be decidedly of opinion that to use electricity of high tension would be a mistake, whereas on the other hand, the greatest authorities in the old country held a diametrically opposite opinion, that there was no difficulty and no danger in using electricity of a very high tension indeed.

Now, looking at it as an outsider, it appeared to him that high tension electricity was similar to high pressure steam. He remembered, and many of the members who were present no doubt would remember also, that with the first introduction of high pressure steam some of our best authorities and some of our most practical men were conscientiously and sincerely opposed to it because it was dangerous, and because it had all sorts of evils in connection with it. Not very long ago, in his own experience, when high pressure came in at something like 180lbs. to the square inch, standing on the top of the boilers, the safety valves blowing off and feeling quite a strange sensation. But now he was quite accustomed to it, and he thought that the difficulty in transmitting electricity of high tension was just the same as the difficulty we had experienced with high pressure steam. Steam, of course, was a very good servant and a very bad master, and he thought that electricity was just about the same. Any accidents that might have happened in connection with the transmission of high tension

currents were entirely due to the imperfection of mechanical appliances or ignorance on the part of the persons in charge. Of course, Mr. Van de Velde laboured under a considerable disadvantage. He was simply coming forward with a statement which told us very decidedly and without any reservation that the present practice of transmitting electricity was all wrong, and that he had got a scheme which was all right. Now, a person in that position making such a statement had a great undertaking before him, and one certainly not to be envied. At the same time he (the speaker) had no doubt that the author was perfectly sincere in what he had stated, but it appeared to him it would have been perhaps very desirable that he should have waited until this scheme of Mr. Van Rysselberghe's had been completed, when he could have given us some more definite information. For instance, did he propose paying for the water, or did he intend to use salt water? He (Mr. Cruickshank) thought the subject had been brought forward rather prematurely, as the scheme appeared to be very incomplete. The main question raised in the paper appeared to be whether it was dangerous or otherwise to transmit electric currents of high tension, and whether by transmitting it in such form and to considerable distances it was possible to obtain uniform light.

He was convinced, as far as his limited experience would allow him to judge, that electricity of a high tension would in the very near future be the standard practice of our electricians.

Mr. A. W. Tournay Hinde remarked that the fact of so many abler persons than himself having very fully discussed the system set forth in the paper, he felt some diffidence in calling attention to a few points in Mr. Van Rysselberghe's system for the distribution of power for electric lighting, not as the paper was entitled a "Hydro-dynamo system of electric lighting," for so far as had been shown the method of lighting proposed was not original, the novelty, if any, must consist in the method of supplying or distributing the power necessary for producing the light.

As other members had already directed attention to the fact some time ago, that power could be commercially distributed from

a centre by means of water or compressed air, and among the uses it could be put to was that of driving dynamos for electric lighting, he thought there was no necessity for him to enlarge upon the subject.

Mr. Van de Velde in the commencement of his paper asked whether any of the members could cite a single instance of an installation of central electric lighting at present running that paid for itself, and at the same time was cheaper for the light produced than gas. To find one we had not to go very far away, viz., Tamworth, in this colony, where the municipality had been lighting their town and also a small portion of private premises for the last eighteen months. The cost formerly for gas was £9 5s. per lamp per annum, with the electric light it had cost only £4 12s. per lamp per annum, which included fuel, water, attendance, renewals, etc., and 10 per cent. for depreciation and interest. Some of the lamps were over a mile from the station, and the plant was worked at an E.M.F. of 100 volts; it was in duplicate, and had run continuously since first installed.

So far as he could see, it appeared to him to be simply a case of hydraulic power and motors versus cables and transformers. Mr. Van de Velde urged in favour of water power, that the cost of the hydraulic mains laid were much less than in the case of electricity, and he gave 1s. per metre as the cost of laying a pipe to transmit six-horse power; this was equal to about £67 per mile. There were at present electric light mains in some of our up-country towns which had cost only £60 per mile, transmitting as much as 18 to 20 horse power, viz., those at Young. Regarding the cost of the apparatus used for transforming the power into electricity of suitable potential for lighting, and supposing we took as an example the case of a private house, with an average of 10 lamps, where M. Van Rysselberghe required in the system he proposes, a water meter, water motor, and dynamo, with its necessary ampere and volt meters, costing, he presumed, by the time they were fixed, somewhere about £35, a low estimate, which was made up as follows:—

Dynamos, 750 watts	£20	0	0
Motor, say	5	0	0
Meter	2	0	0
Amp. and volt ditto	7	10	0
Twenty-five per cent. for fixing ...	4	2	6
	£38	12	6

Instead of this apparatus, with its necessary wear and tear, oil, brushes, interest on plant, etc., there were at present in successful use Electrical Transformers, doing all that Mr. Van Rysselberghe's apparatus would do, and costing for the same power £10, including 25 per cent. for fixing.

Again, Mr. Van de Velde said the losses in transmission by his system were less than by electricity ; and well they need be, for if the efficiency between generating station and point of supply was taken into account, the results yielded were remarkable.

Taking another example, and working from the private consumer back to the generating station, in the first place, we had the hydraulic motor and dynamo. Mr. Van de Velde gave the efficiency of the motor at 50 per cent. for a small power. Now, those who had had anything to do with the making of dynamos knew that with a machine so small as one horse-power (which was sufficient for 10 lights) that the highest commercial efficiency obtainable even with a high-priced machine, was not much above 75 per cent. Here, then, neglecting the loss in the meter, we had 50 per cent. and 25 per cent., or 75 per cent. altogether, to place down as the first loss; and then, for argument's sake, assuming that the loss in the pipes or transmission was *nil*, we had to deduct the loss in the main pump at the generating station, say, 20 per cent., or a total loss of 85 per cent.; that was, 15 per cent. of the total power only was available for lighting purposes; or, for the one horse-power at the house it would take 6.66 horse power at the generating station.

Viewing electricity in the same way, we must first consider the transformer, and, taking this at full load, as in the other case, we had an efficiency of about 86 per cent.; this was all the loss at the house, and allowing in this case a loss of 5 per cent. in the mains, which was high, we had an efficiency of 81 per cent., and deducting from this the loss between the dynamo and the engine, say, 9 per cent., or a total of 70 per cent., which was available for lighting; or, as before, for the one horse-power at the house, it would require 1.43 at the generating station.

It was almost needless to add that if storage batteries were used in connection with the hydraulic motor and dynamo, as proposed in one part of the paper, that the losses would be still further increased.

Of course he (the speaker) was well aware that efficiency in the methods employed did not necessarily always mean a commercially paying concern, but in this case it had been clearly shown that the medium proposed to be employed was costly, that the machinery and mains were more costly than those at present in use, and their efficiency was much lower, so that he did not see when Mr. Van de Velde stated that the present electrical systems could not be made to pay, how his system could, especially if the total interest and depreciation of all the scattered plants was taken into consideration. He trusted in Mr. Van de Velde's reply he would endeavour to explain some of the enigmas which at present surrounded Mr. Van Rysselberghe's system of distribution of power for electric lighting which he proposed the municipal councils of this colony should take up.

Mr. Webb said he would like to give a few figures showing transformer efficiencies obtained at a test at Frankfort-on-Main :—

Full load ...	...	...	95 to 96 per cent.
Half load ...	...	...	93 to 94 „ „
Quarter load	...	...	90 per cent.
One-eighth load ...		...	80 to 82

Mr. Fitzmaurice said he would like to explain Mr. Cruickshank's reference to himself with regard to the high tension

system. He (the speaker) limited his remarks to 1,500 volts tension. 1,000 to 1,500 volts could be carried with safety, but over that tension it was troublesome. Electricity was quite different to steam. It had a great many more obstacles to contend against.

The President stated that before calling on Mr. Van de Velde to reply, he thought it would be admitted that the references in the paper to himself should be answered.

In the fourth paragraph, page 31, the author said as follows: "You will see from the substance of the paper to which the author now asks your attention, that if our President had gone a little deeper into the matter he would probably have arrived at a slightly different conclusion." Again, in the seventh paragraph, page 34, he said: "This is the conclusion arrived at by one of the ablest electricians of the day, and yet in the face of it our President in his last address gives the example of an American Company which intends to carry the electric current to a distance of no less than twelve miles before distributing it." The information here questioned was published in the *Engineering and Mining Journal* on the 4th January, 1890, and was as follows: "The Westinghouse Electric Company has just closed an important contract with the Wellametta Light Company, of Portland, Ore. The company is to furnish 10,000 incandescent and 100 arc lamps, together with the wire necessary for operating the same. *The current is to be carried twelve miles before being distributed*, a thing never before attempted in this country. For that purpose a specially constructed machine, capable of producing 4,000 volts is to be used. The cost of the entire plant, including the distributing station building, will be in the neighbourhood of $200,000. The completion of this plant will be the inauguration of electric lighting in that city."

That proved conclusively the accuracy of the remarks contained in his Presidential address.

There were several other matters he would have liked to have dealt with; but as so many had spoken on the question and had invariably taken the same side, he thought it unnecessary to follow the same line.

Before concluding he wished to draw attention to certain contradictions which appeared in the paper, and would cite as examples the following paragraphs:—

"*Electricity cannot be transported economically.* Facts have demonstrated the veracity of this conclusion."

"Electricity at high tension is transported comparatively cheaply, but it becomes dangerous for those manipulating the machines and the wires. In more than one American city, the transport of electricity is done at 4,000 volts tension, but it would be difficult to number the victims it has made."

"In conclusion, the electric current, which in the general opinion is so easily transported, is not transportable at all."

And again:—

"It is quite possible to create in the heart of a big city, where one can depend upon a large consumption within a small radius, a central station for the production of electricity, and so compete advantageously with gas from a purely economical point of view."

"Are there any of you gentlemen who could name a company that sells the electric light at the same price as gas, the said company being in a prosperous condition, and paying a reasonable dividend?"

Regarding the cost of cables, it had been conclusively proved by experience that electric currents of a very high tension could be carried upon an exceedingly small wire, and it was a perfectly erroneous statement of Mr. Van de Velde's that it was necessary to pay fabulous sums for them. There were many things in the paper that might be debated, but he thought they all tended in the one direction; and so long as he had proved to you satisfactorily that the remarks he made in his opening address this year were what you would naturally expect them to be—authentic—he (the President) was perfectly satisfied.

Mr. Van de Velde, in reply to the various criticisms on his paper, stated with regard to his remark that the electric current was not transportable had evidently been misconstrued, as what he intended to have conveyed was that it could not be economically

transported. He was sorry he had omitted to mention in the paper that M. Van Rysselberghe proposed to use salt water, as this would of course materially reduce the cost of the system. Mr. N. Selfe had asked a number of questions, but he (the speaker) was sorry he could not supply the information at present, but he hoped on some future occasion to have the opportunity of again bringing this matter before the Association, when he would be in a position to supply all data asked for and also exhibit one of the motors.

The President, in conveying the vote of thanks to the author, remarked that though we had ranged ourselves opposite to Mr. Van de Velde yet we had derived a considerable amount of information in consequence of his reading this paper. The discussion of such a question was exceedingly beneficial to our members. It induced them to study the subject thoroughly so that they might be prepared to answer whatever arguments were used in the course of discussion. There was no doubt that Mr. Van de Velde laboured under a very great disadvantage here from the simple fact that he had not a motor or a model of a motor, nor yet had he plans or anything by which he could give us an accurate idea of the proposed machine. However, he (the speaker) was sure the thanks of the Association were due to Mr. Van de Velde for his paper. With regard to the utilisation of salt water in connection with Mr. Van Rysselberghe's scheme, the question was what action it would have upon a pipe at a pressure of 750 lbs. to the square inch. If he might use his judgment on a matter of that kind, he would say that instead of having pipes underground, as the municipal authorities had to-day, for seven years, he questioned whether they would last three years. Experience must prove conclusively to us what influence salt water would have under such circumstances before Mr. Van de Velde's scheme could be successfully put before the public. He was sure that those of you who had differed from the views promulgated by Mr. Van de Velde had based your objections upon what you believed to be your own practical experience coupled with what you have read, and you have done so in all sincerity. He was also perfectly satisfied that if in the future Mr. Van de Velde could prove to you that the motor he

was advocating was one it would be to the interest of the community to adopt, that there was not one among you who would not turn round and give him every assistance in bringing his scheme to a successful issue. On behalf of the Association he had much pleasure in thanking Mr. Van de Velde for his paper.