the venture? If so, give me the concession, capitalists are ready to support me, and if I succeed you can take over the whole concern."

You see from this that if ever an inventor did believe in his invention it is M. Van Rysselberghe.

But it is not enough to *advance* these facts; they have to be proved. Why has electricity not kept the beautiful promises that were made in its name after the Paris Exhibition of 1881? Simply because its practical transport, in large quantities, for the requirements of public lighting, necessitate wires of pure copper of colossal size, and pure copper costs over a shilling a pound. Up to the present the whole question lies there. The difficulty is of a purely financial order: copper is too expensive, but there are no technical difficulties.

What is required for an incandescent lamp to burn and be preserved? Only one thing; that is, that it be submitted to a regular and constant electric pressure. This pressure is measured in "volts." The usual lamp is constructed for 100 volts; if it is supplied with a current at 98 volts it furnishes very little light; if it receives 104 volts, it does not last, it soon flies into fragments, as would an overworked steam boiler. A constant electric pressure is absolutely necessary.

A similar condition is necessary for a distribution of gas, the pressure must be uniform in the whole length of the pipes, and above all, *the pressure should remain uniform, whatever may be at a certain moment the amount of the consumption.* To obtain this regularity of pressure, the resistance of the pipes should be reduced to nothing.

People are sometimes surprised at the size of pipes put in the ground for distributing gas over the city. These pipes seem to be of an extravagant size when it is thought that they have only to carry so subtile a fluid, lighter than air. Why these enormous pipes? they say. Simply to reduce to almost nothing the resistance that their surface might offer to the motion of the gas; in other words, to render the pressure uniform and assure the mutual independence of all the lights.

The same should be done with electricity. The resistance of the wires has to be reduced to an unquotable quantity; then the service would be simple and practical—as simple for electric light as for gas, for the requisite conditions would be identical in both cases. But reducing the resistance in an electric reticulation to an unquotable quantity practically *nil*, is not to be thought of, for copper is too expensive. Take for example the lighting 10,000 lamps, placed at 1,000 meters from the central station, by direct distribution at 100 volts, and admitting even five per cent. loss, which quantity, however, ought not to be neglected in practice, as we should not tolerate more than one per cent. But even if the loss is five per cent. it would require pure copper bars of 20 centimetres square. This would represent 720,000 kilogrammes of copper (or 720 tons) at 2s., say £72,000 worth of copper, and which only represents the value of the copper. If we now consider that the wires have to be insulated very carefully, and that the insulation costs at least as much as the copper, that would represent £144,000 buried in the ground with the aggravating consideration that up to the present we are not at all certain about the durability of copper cables for electric lighting.

At Berlin they have thus placed £100,000 worth of cables, which, after three years service, have failed.

Professor Forbes, who, like M. Van Rysselburghe, has studied the principal electric stations in Europe and in the United States (in the Journal of the Institution of Electrical Engineers, of 1889, No. 78, page 188) states as follows:—

"We have now to consider a very important and perhaps the most difficult part of the problem of lighting by central stations: how to preserve the insulation? . . . During late years one has much praised a kind of cable to which I wish to refer. The copper conductor, twisted or not, is covered with a fibrous material, preferably hemp, impregnated with bituminous oil, and then enclosed into lead tube. In this kind of cable the insulation depends upon the impermeability of the lead.

"We all know that cables of that kind have rendered good service, for a limited time, and many of us were tempted to believe that they were very satisfactory. But I think I am right in saying that none of us has any knowledge of those cables having successfully worked anywhere for more than three or four years."

The author thinks that in view of the opinion expressed by such an authority as Professor Forbes, it would not be rash to propose for the city of Sydney a system which does away with cables and the extravagant expenses connected therewith; but it would be extremely rash to follow the old track, the future of which is so very uncertain. Some may say that we can use other cables, insulated, for instance, with gutta-percha, costing only from 12 to 15 francs per kilo. That is true, but gutta percha, the best insulator known, only retains its condition when completely under water.

There are a great number of ways of obtaining a good insulation; for instance, by increasing the thickness and number of rubber coverings, and enclosing the cables in cast-iron or stone-ware pipes, etc. There is no practical difficulty, but there is always the important question of cost. To obtain by electricity as simple and practical a service as with gas, the electric resistance of the cables ought to be reduced to an unquotable quantity, but this cannot be thought of on account of copper and india-rubber being too expensive.

What is being done under the circumstances?

This: They have recourse to expedients and artifice. First of all they light the best part of the city, the portion where large consumers are close together, and the other quarters are left alone until better times. After that, not being able to establish the stations in distant places from the centre, where land could be purchased at reasonable prices, and where all the necessary space could be obtained for a good and practical installation, but being obliged to erect electric batteries and steam engines of several thousands of horse-power on very valuable land, where, for want of room, they put the engines one on top of the other, going sometimes as far as superposing two stories of steam boilers, as has been done in New York. Or they excavate the ground and get under the river beds, where the men get half smothered in underground galleries, and also run the risk of blowing up everything above.

Imagine erecting steam boilers of many thousands horse power in the very heart of the city! This is the point we are reaching, and logically so, for on account of the expense there would be no chance of doing otherwise.

And this is not all; for being obliged, notwithstanding the practical insufficiency of the cables to maintain a uniform electrical pressure at every point of consumption, they are forced to constantly modify the run of the dynamos, according to the variations of the consumption. Intelligent, careful, and experienced men succeed in performing even that feat, but is it a merit to be placed to the credit of the system?

What would the Chief Engineer of the gasworks say if he were told by the Board of Directors: We are going to remove the gasworks and alter the pipes in the city. These pipes will be reduced to one quarter of their present diameter. In reference to space, it will have to be strictly limited to the requirements of the gas-holders. You must put the retorts on the second floor, above the gas-holders; all the rest of the plant on the third floor, and you must store the coke where you can manage it. The gentleman referred to would probably succeed in building up such extraordinary gasworks as pictured, but surely he would never show them as an example to be followed.

But again, what is absurd in one case beomes logical when the question arises of the establishment of a central electric station according to the present practice. Electricity consumed on the spot where it is produced is a cheaper light than gas; but its transmission to a distance is costly. If such affirmation required proving he would give as an example the North Railway Station in Brussels, where the substitution of electricity for gas has resulted in a considerable economy to the Belgian Government.

Unfortunately, owing to the important and expensive machinery required, it is only large consumers who can afford to produce the electric light themselves. But we have the high pressure water motors. We have the Barker's Mill, which is very simple in construction, and requires but little attention when working. Let us apply it direct to the axle of a dynamo and open the watercock, and the current is at once generated. There are, of course, some important details. For instance, it is necessary to admit the water through the axle, through a water-tight joint, without there being detrimental wear. Above all, and this is the important point, the motor has to revolve at a uniform speed, whatever may be the variations of the hydraulic pressure or of the consumption of light. But those conditions being obtained, as there are dynamos furnishing a constant electric pressure, whatever may be the number of lights, provided only that the speed be uniform, one will arrive in a very simple way at this result—so difficult to obtain with a direct distribution of electricity, that each consumer will be independent of all the others. This uniformity in the speed, in spite of the fluctuation of the hydraulic pressure, and the variable quantity of light consumed, seems to be at first sight, an enormous difficulty. But M. Van Rysselberghe says it is a repetition of the story of Columbus and the egg—he has found the simple and elementary solution.

There is another objection which is met in the same manner: —"If the joint of a large pipe breaks, everything is stopped." Not so, everything is not stopped; there is only a small section momentarily out of service. The reticulation is double, and in sections. If a joint bursts (the accident seldom happens, but has to be foreseen) two valves are shut automatically, and the escape is instantaneously stopped. Now the question arises, at what price can the water power be furnished, and at what cost to the consumer can the light be produced by this method? It is to be noted that here we have positive bases to calculate upon, known for long, and sanctioned by a practical experience of more than a quarter of a century.

A power distribution by water at 50 atmospheres has existed for over twenty-five years in London, and it covers to-day the whole surface of the immense metropolis. A similar distribution has existed in Antwerp for about ten years, and works to the satisfaction of all. It is known by experience what are the practical diameters and thicknesses of metal required for an hydraulic reticulation of this description; their cost is known, and what is very important, it is also known that the hydraulic pipes, contrary to electric cables, remain undamaged in the ground.

In Brussels—and it would not be much higher in Sydney—the cost of water at pressure of 50 atmospheres would be 17½ centimes per cubic meter; it is proposed to sell at 35—which represents a profit of 100 per cent. for the company.

The conclusion to be drawn from this is that if the lighting of the city with M. Van Rysselberghe's scheme were undertaken by the municipality it would be for them a source of important revenue. The sale price of 35 centimes per cubic meter being adopted, what would be the cost of the electric light to the consumer? It can be calculated as follows:—

The duty of the hydraulic motor being put down at the small minimum of 50 per cent., M. Van Rysselberghe has made the following calculations for consumers in Brussels:—

He takes first the case of a small installation of 20 lamps of 50 watts each, and calculates on an average of four hours a day lighting:—

COST OF PLANT.

	Francs.
Hydro-dynamo machine of 2,000 watts (equal to 40 lamps)	1,500
Erection	400
Measuring instruments, &c.	400
Capital	2,300

ANNUAL EXPENSES.

	Francs.
Interest and sinking fund of ten per cent. ...	230
Rent of water meter	50
2,000 metres of water, at 35 centimes	700
Miscellaneous	20
	1,000

Or 50 francs per lamp for 1,460 hours of lighting, or 3½ centimes per lamp and per hour, which is in Brussels the price of gas, with an equivalent profit to the producer.

Supposing, now, an installation of some importance, say 100 lamps of 50 watts :—

Cost of Plant.

	Francs.
Hydro-electro machine of 6,000 watts (equal to 120 lamps)	3,000
Erection	500
Measuring instruments, &c.	500
Capital	4,000

Annual Expenses.

	Francs.
Interest and redemption fund, ten per cent. ...	400
Rent of water meter	50
10,000 metres at 0·35fr.	3,500
Miscellaneous	50
Total	4,000

Or 40fr. per lamp, and for 1,460 hours of lighting, or $2\frac{3}{4}$ centimes per hour per lamp. This is much cheaper than gas, and yet it leaves a profit of 100 per cent. to the producer.

Is there now any doubt about the cost of water power at 50 atmospheres which M. Van Rysselberghe says would be $17\frac{1}{2}$ c.m. Brussels? Ten years' experience in Antwerp has shown that a cubic meter can be delivered at a pressure of 50 atmospheres at a cost of eight centimes for coal, oil and grease.

Does a yield of 50 per cent. for the hydraulic motor seem too high? We all know that very often they reach 85 per cent.

Only one other doubt may still exist in your minds, that is, with regard to the value of Mons. Van Rysselberghe's hydraulic motor. The method proposed for the general lighting of a city ensures the hydro-electric machine being simple and trustworthy enough to be left to itself like a gas meter, in the care of anyone, who will only be required to open or close the cock, leaving, if so desired, to the care of the company, the occasional inspection of the dynamo.

The author wishes to mention that M. Van Rysselberghe's hydro-electric machines have been in practical use for several months in Antwerp, and that before long the greatest part of the city of Brussels will be lighted on the same principle. Again, with this system it is presumed that every important consumer will have his own hydro-electric machine, but for the lighting of the streets, and the large number of private houses where they will not care to go in for the purchase of the machine, local stations of moderate importance would be established in a cellar or yard. Each station would be composed of a series of accumulators which would be charged during the day by the hydro-electric machine, and this station would distribute, within a small radius, the electric energy to consumers of less importance. These latter consumers would, of course, be charged at slightly higher rates.

The author, during his recent stay in Europe, has had the opportunity of discussing this important and interesting question, not only with M. Van Rysselberghe himself, but with many engineers possessing the highest qualifications and repute on the subject, and in their minds there seems to remain no doubt whatever as to the truth and practicability of the scheme advocated. All are agreed that, thanks to M. Van Rysselberghe, electric light can be now produced cheaper than gas, and that the question of the general lighting of cities and private houses is solved.

There are at the present moment several Australian Municipal Councils about to adopt the electric light on the old principle, the absurdity of which, the author hopes, he has proved. And he trusts that when the report of this meeting shall have reached them, they will for the sake of their Municipal finances, pause, and make no hasty decision, at least until full inquiries have been made as to the merits of the system he has had the honor to introduce and advocate. One thing is certain : Everything that may be done on the old principles will have to be undone.