which till a very recent time was wanting, have established. But have these principles been mastered as yet by our population? I think not. Our political commonplaces, those so-called principles the announcement of which sets all throats shouting and all hands clapping, are in a great degree exploded in the schools. In the schools the historical has supplanted the *à priori* method, whereas the party-world still lives in the dregs of eighteenth-century Liberalism. That impartial view at which you aim is, in fact, a historical view. When the party-scales fall from our eyes, what we see before us is simply history. "The thing which hath been is the thing which will be." Would you know what is wise and right in politics, you must consult experience. In politics, as in other departments, wisdom consists in the knowledge of the laws that govern the phenomena, and these laws can only be discovered by the observation of facts. Now, in the political department we call the observation of facts, history. If this is so, how can we avoid the conclusion that such a study of politics as you meditate cannot be separated from the study of history?

You will allow me, I am sure, thus frankly to point out the difficulties with which you will have to contend. It may prove that a more complicated machinery than you have planned is necessary in order to carry your purpose worthily into effect. And in that case it is, of course, possible that you may find on trial that you have undertaken more than you can perform in a manner thoroughly satisfactory. Even so your society might still be infinitely useful. Its discussions might be suggestive, even if they should not be exhaustive; they might give much, even if they should leave you hungering for more.

On the other hand, you may find yourselves able to give to your society that further development which the plan of it seems to me likely to require. What, in one word, is this further development? To discussion, it seems to me, you may wish to add methodical teaching, and to politics you may wish to add political economy and history. These, indeed, are vast additions; they would convert your debating society into something which we should describe by quite another name, into a sort of institute or college of the political sciences. You may not be prepared, and perhaps even it would not be wise, to look so far forward, to undertake so much at once, or even to indulge the thought of ever undertaking so much. But in a solemn commencement like this, it is impossible not to speculate, at least for a moment, to what height the seed now sown may conceivably grow. In an inaugural address, allow me to adopt for a moment the tone of an augur. It is now seventeen years since, in the Senate House of the University of Cambridge, I delivered a lecture on the teaching of politics. Ever since that time, but especially during the last ten years, I have observed in different parts of the country how the idea of regarding politics as a matter of teaching makes way, and how the demand for political teaching grows. The movement here connects itself in my mind with many similar movements which I have had the opportunity of observing, and therefore I think I can foresee the course it is likely to take. Now observe that if you find difficulties in realizing what you wish, you may get help. You want better knowledge, and you may possibly find, as I have said, the subject too vast for you to grapple with unaided. You may come to think that you want the help of economists and historians, if not of other classes of learned men. Your discussions may leave you craving for something more systematic; they may suggest doubts which you would like to refer to investigators of authority. If so, do not forget that the old universities are now very different from what they used to be. Whatever knowledge, whatever insight can be found there, is very much at your service. If in former times their studies were too little practical, had too little bearing upon the questions which agitate the world, this can scarcely be said now. If in former times the scholars of the universities were wrapped up in monastic seclusion and took little interest in the topics of the day, this again can scarcely be said now. But you are not likely to forget this, for I understand the university extension lecturers have visited this neighborhood. Possibly, however, it has not occurred to you that the two schemes, university extension and this Society for the Impartial Study of Political Questions, belong to and have an affinity with each other. We have at Cambridge economists, and we have also historians who do not shun the actual times in which we are all living. In the extension scheme, and other similar schemes, we have a machinery by which these academic teachers are brought easily within reach of those who in great towns like this feel the want of academic teaching. I do not overrate the value of this kind of help. The time was, no doubt, when such scholastic politics would have been regarded with contempt, and I do not suppose that even now you are accustomed to expect much light upon practical questions from the collegians of Cambridge and Oxford. Nevertheless, I think you have found out already that they have something to give, and if you will only persist in appealing for their help, I believe you will be more and more satisfied with the result. The demand will create the supply. They will find out what you want, and gradually they will prepare themselves to give it. Here, then, is my suggestion. You seem to recognize already that you will need help of some kind. You have asked distinguished men, some of them strangers, to deliver lectures which are to be introductory to your discussions. I say, then, for the future, when you want such lecturers, go for them sometimes to the universities. And if you find, as you may do, that, on such a subject as free trade, for instance, a single lecture, or a pair of lectures, one on each side, is not sufficient, and rather disturbs your mind than quiets it; if you begin to see whole sciences and systems of thought lying under those political questions which you have undertaken to study impartially, then, I say, call the extension lecturers back to Cardiff, and supplement your debates by courses of lectures and by standing classes in political economy and in history.

You see, no doubt, what I aim at. What leads me to take an interest in your enterprise, what has caused me to accept with pleasure your invitation to deliver this address, is that I have recognized here another wave in the great tide of which I have for many years watched the advance. It is our part at the universities to give coherence, connection, and system to the thinking of the nation. I see everywhere how the nation begins to strive more than in past times towards such coherence. I am glad also to see how it learns the habit of looking to the universities for help in this strife, and how rapidly the universities are acquiring the habit and the skill to render such help; and I look forward to the time when the English universities will extend their action over the whole community by creating a vast order of high-class popular teachers, who shall lend their aid everywhere in the impartial study of great questions, political or other, and so play a part in the guidance of the national mind such as has never been played by universities in any other country. It is in this hope, and as a step to the fulfilment of it, that I inaugurate and wish all success to your society.

ELECTRICAL SCIENCE.

The Solution of Municipal Rapid Transit.

THE paper read by Mr. F. J. Sprague before the Institute of Electrical Engineers, on municipal rapid transit, is both valuable and timely. In the first part of the paper the inadequacy of the almost universal system of horse-car traction is pointed out, and a comparison is made between horses, cables, and electricity. Taking up horses, Mr. Sprague says: "Two distinct methods are recognized among street-car men in the handling of their stable equipments. In one the stock of horses is kept as low as possible: they are worked hard, making fourteen or fifteen miles a day, and the depreciation is heavy. In the other the stable equipment is increased, the horses are kept in excellent condition, their average daily duty is reduced to ten or twelve miles, and the depreciation is lessened." As an example of the equipment required, on the Fourth Avenue line in New York, run on the latter plan, the car day is eleven hours, and eight horses make about five trips, aggregating about fifty miles. To the number of horses is added ten per cent for illness, and ten per cent for emergencies; that is nearly ten horses for a car, making fifty miles a day. The average cost of motive power per car day throughout the United States is about four dollars, counting the cost of only those horses that are actually on duty. The cost per day per horse in New York is on the average fifty-four cents, and the cost for motive power per car mile ten cents.

The cable system has been successfully used where there are heavy grades and a great deal of traffic. In this system a cable is

run in a conduit between the tracks, and the cars make connection with it by a grip passing through a slot in the conduit. There are several objections to this system. One of the most serious is the initial cost, the conduit alone costing from $50,000 to $80,000 per mile of single track. The conduit must be made large, it is difficult to clean, the pressure is liable to distort it and close the slot; its depth — varying from two to three feet — is liable to interfere with steam, gas, or water pipe. A break in the cable will suspend the entire traffic on the line. A broken strand is apt to foul the grip and pile one car on another, as has happened in Philadelphia. The efficiency of the system is not over twenty to twenty-five per cent, while to guard against accident the engine outfit is usually from two to four times that required at any time. Any extension of a cable line is expensive because the length of the cable is fixed. The speed of the cars is limited to that of the cable, so there is no chance for them to catch up if they get behind time; the motion, too, is uneven and unpleasant.

For electric traction Mr. Sprague claims the following advantages. It will do the work more satisfactorily and at a less cost than horses; on levels and up and down grades electric-motor cars can be run much faster than horse-cars; they can be gotten under way and stopped much more quickly; the equipment will occupy thirty-five per cent less space than horse-cars, the horse space being saved, and this fact, together with the ability to back when necessary and to quickly gain headway, enables an electric car in a narrow and crowded street to work a passage through where horse-cars would be stopped. Electric cars can be run more safely on down grades, since if the brake-chain breaks the car can be controlled by the motors, reversing when necessary. The motion of an electric car is smooth, and its starting and stopping are easy; the cars are clean, they can be lighted and heated by electricity; the streets are cleaner, and objectionable stables are not needed. It becomes feasible to operate branch lines, and also combinations of grades, curves, and ill-conditioned streets, that would be prohibitory to any other system.

To the objections that have been urged against electric systems, — that an extended system cannot be operated by electricity, that the lines may break down, that a large number of cars cannot be operated simultaneously, especially when bunched up, and that armatures and brushes burn up, — Mr. Sprague opposes his own very extensive experience, especially in the case of the Union Passenger Railroad in Richmond, where all of these difficulties have been met and overcome.

Before giving the details of the Richmond road, Mr. Sprague explained from curves some important points in the theory of electric motors for traction work. Discussing the different methods of gearing the armature of the motor to the axles of the car wheels in order to reduce the velocity, he concludes that there is only one good way, which is to centre the motor on the axle, suspending it flexibly from the car body or truck, and driving the axle by gearing with one or two reductions according to the nature of the service.

Taking up the methods of supplying the current to the motors, from storage-batteries on the cars, from overhead wires, or from wires in a conduit underground, Mr. Sprague first discusses storage batteries. These he considers as extremely promising for surface traction, but at the present state of development the excessive weight, the depreciation and cost, lack of capacity, and the space taken up in the car, make their success problematic. The weight of the car is so great — almost 20,000 pounds for a loaded car — that many of the tracks now in use would have to be rebuilt for them.

The difference in cost between an overhead and conduit system is mainly in the cost of the conduit, $25,000 to $30,000 a mile. The latter has the advantage that there are no overhead obstructions, and it can therefore be used in streets where the former is not permitted. Its disadvantages are cost, possibilities of leakage, and difficulty in cleaning and repair.

The overhead system is cheap, easily insulated and repaired; if properly constructed it need not be unornamental nor dangerous, — in fact the electrical pressure should not be great enough to endanger life. Mr. Sprague recommends this system for suburban districts, for comparatively narrow streets, for all streets operating under an elevated railroad structure, or where the tracks are near a sidewalk.

To illustrate the advantages of electricity for certain classes of traction work, Mr. Sprague proceeded to describe the equipment and operation of the Richmond street railroad, a description of which has appeared in this journal. The road is a difficult one, practically impossible for horse traction. There are grades of over ten feet in a hundred, and curves of small radius on heavy grades. The total trackage is twelve miles, the equipment is forty cars. Each car axle is geared to a motor of 7½-horse power, capable of working up to 15-horse power if required. The motors are out of sight, and are practically noiseless. The system used is the overhead. The power station is in the middle of the line, and is provided with boilers and engines of 375-horse power. In distributing the current a main conductor is taken along the line of track, either on the poles or underground, and is connected at intervals to the overhead working conductor, from which the current is taken. This allows a small overhead wire, and a break in it will not interrupt the traffic on the line. The return circuit is through the car-wheels to the rails and the earth. This road has been running long enough to allow reliable figures as to the expense being obtained. It is found that the cost of power is $1.48 per car day, the car making eighty miles, and of material, labor, and depreciation, $1.98 per car day; the total being $3.46 per car day, or 4.32 cents per car mile. This is to be compared with the ten cents a car mile that horses cost, and in the latter estimate there is no allowance for depreciation of cars, etc. At present there is a saving in this line of $125 a day as compared with horses. The passengers carried are over 10,000 per day.

Passing to the application of electricity on a larger scale, Mr. Sprague considers the problem of the elevated roads. At present steam engines weighing 22½ tons, with a capacity of 185-horse power are used. For a proper service the number of cars should be increased at certain hours, but the weight of the locomotive will not give traction enough for the desired increase, and the strength of the structure will not allow an increase in its weight. As to the energy used, 59 per cent is employed in starting, 24 per cent in lifting, 17 per cent in traction; the average horse power is 70.3. Mr. Sprague's substitute for the locomotive is a car with an electric motor geared to each axle. In stopping and in going down grades he will brake by making his motors into dynamos, feeding current into the line for the other trains, thus recovering a part of the energy lost in starting and in going up grade. The motors are to have a collective capacity of 300-horse power, and the car will be used for passengers: at each end of it will be a compartment for the motor men.

Mr. Sprague's ideal railroad system for New York is as follows: There would be four tracks from the Battery up Broadway to Twenty-third street; thence diverging in two divisions, each still with four tracks, one along the line of Madison Avenue to the Harlem River; the other following Broadway and running up the line of the Boulevard and Tenth or Eleventh Avenue. Two tracks would be for express, two for way traffic: they would be in two tiers, the former below the latter. Electric cars are to be used, the current delivered from an overhead wire; express speed, thirty miles, way trains, twelve miles per hour. This system is to be supplemented by surface cars operated by electricity.

These are the main points in Mr. Sprague's paper, which will be discussed in the fall meeting of the Institute of Electrical Engineers.

MENTAL SCIENCE.

Experiments in Thought-Transferrence.

THE English Society for Psychical Research has definitely accepted the theory of telepathy, or a mode of communication between mind and mind other than that through the recognized channels of sensation. A portion of the evidence upon which they found that belief is of an experimental nature, and it is this portion that is most apt to arouse the attention of scientific men; it is this portion, too, that is certain to bring to light obscure phases of mental action, irrespective of the answer it may yield as to the possibility or impossibility of thought-transferrence. In the last issue of the Proceedings of the English Society (June, 1888), M. Charles Richet, well known as a physiologist, and editor of the