by a number of electric tramways at present in operation. The only question is, will considerations of safety and æsthetics allow the current to be economically conveyed to the cars? For instance: in the Sprague Electric Railway in Richmond, using an overhead conductor, it is costing for power about $1.70 per day per car, the cars averaging over eighty miles. This is for only twenty cars. When the full complement is running, the cost will be reduced, probably to about $1.50 per car per day. This cost is to be compared with the $5 or $6 that must be allowed per car per day for horses, at an average of, say, 60 miles per car per day. If the overhead system could be used, then, in all of our cities, there would be no doubt as to the results as far as street-car traction goes. When it comes to ordinary railroad-work, the state of affairs is very different. The question is, shall we substitute for steam, used directly, a power which is in the first place derived from steam, and which suffers the losses due to at least two transformations before it is utilized in driving the train? As far as mere economy of power-production goes, the question is easily answered: the efficiency of a stationary steam-plant is greater than that of a locomotive-engine; and the cost of a horse-power delivered to the driving-axles of the train by the electric motor would not be more for coal, attendance, and depreciation, than the same power from the locomotive, even after allowing for all the losses in the different transformations. The advantages of the electric motor are these: the driving-machinery is the simplest that it is possible to conceive of; the armature of the motor would be fitted directly on the car-axle, while the field-magnets would rest on the truck. Each axle would have its motor, and in a train every second or third car would be a motor-car. One advantage of this has been pointed out, first, probably, by Prof. George Forbes. Taking a six-car train, we would have the traction, not of four wheels, but of sixteen, supposing two motor-cars. This will enable us to make any speed that safety will allow, to start quickly, and to take at high speeds, grades that at present are inadmissible. In fact, we can dispense with a great deal of the grading that makes the construction of railroad-lines so costly. Again: on the down grades we can make our motors into dynamos feeding current into the line, — a plan due, I think, to Mr. Sprague, — instead of wasting energy by braking the wheels; and we can in the same way brake the cars when stopping. The advantages, then, are great simplicity, increased traction, allowing an increase of speed and a decrease in the cost of constructing the road, recovery of energy on down grades and in stopping. As compared with city electric tramways, such as are now in use, railroads would have the advantages of simplicity, in not requiring any gearing between the motor and car-axle, and in allowing any economical means of conducting the current to the car, and the employment of high electro-motive forces. There is one great disadvantage, however, that the future may remove, but which at present is serious. A station supplying any portion of the line will have to have a capacity equal to the maximum work that will be required of it at any time, while the mean work might be very much less than this. As the maximum may differ from the average work five or six times, we would have to equip stations of five or six times the present capacity of the locomotives, at a cost that would throw the balance in favor of the present system, unless there happened to be very considerable sources of natural power along the line. The remedy for this — a remedy which cannot be at present applied — is in equipping the stations with storage-batteries; charging them when the required power is below the average, drawing from them when it is above. We may say, then, that, with long-distance direct lighting and electric tramways, electric railways wait the development of a more perfect storage-battery to be successful.

ELECTRIC PHENOMENA PROVOKED BY RADIATION. — Very lately considerable attention has been attracted to the effect of light on the phenomena of electrical discharge, the light generally increasing the effects, allowing discharge where it would not otherwise occur. In the *Philosophical Magazine* for April, Professor Righi gives a preliminary account of some interesting experiments he is trying in the same field. Two metals, one in the form of a disk, the other a net, are placed opposite one another. One of the metals, A, is connected with one pair of quadrants of an electrometer; the other metal is connected with the other pair and the earth; and the needle is charged. If A is illuminated, a deflection is obtained which reaches a maximum in a time which is shorter the nearer the irradiating source and the larger the surface of the metals. The sun's light does not produce this effect in a marked way: the magnesium light is more active; the voltaic arc gives the best results. It is probable that the ultra-violet rays are the most active. Four of these 'photo-electrical cells' are connected in series, and give the same results as ordinary cells in series on open circuit.

HEALTH MATTERS.

Portagiousness of Consumption.

IN a recent paper presented to the Medical Press Association of St. Louis, Dr. William Porter discusses the 'portagiousness of phthisis.' He prefers the word 'portagious,' because it conveys a more exact idea of the manner of transmission of phthisis than either 'contagious' or 'infectious.' In his paper the term 'phthisis' is used to denote that class of disease to which belongs the large majority of cases of slowly progressive pulmonary inflammations; i.e., chronic tubercular phthisis.

Dr. Porter propounds the following question: 'Have we reasonable evidence that the products of, or emanations from, a phthisical subject may be carried to, received by, and cause like disease in, one previously free from phthisis?' The answer to this question he thinks must be answered in the affirmative, and quotes the following experiments as sustaining this view. In experiments made by Tappeiner in 1883, tuberculous sputa being inhaled by eighteen healthy animals, tubercles in both lungs, and pleura, were afterwards found in seventeen. That record of Koch's work found in the second volume of the 'Imperial Health Reports,' shows, that, after the inhalation of material from phthisical cavities, the rabbits and guinea-pigs under observation had, within twenty-eight days, tubercles throughout the lungs of all, and in the liver and spleen of some. The carefully conducted investigations of Cadeac and Mullet, recently published, show, that while no positive result was obtained from compelling rabbits and guinea-pigs to inspire air exhaled by phthisical patients, yet when air was used collected from near the beds of hospital inmates, the air presumably carrying particles of sputa, two out of twelve guinea-pigs acquired tubercle.

The writer refers to some experiments which he made, to determine this point. "Three healthy guinea-pigs were selected. One was inoculated with phthisical sputa, and placed in a small box with one of the others. The third was confined in a box in an adjoining room. They were cared for alike, and had similar food. In four weeks the first one died, and the examination showed tubercle in the lungs, and a large cheesy gland near the point of inoculation. Three weeks after, the second animal sickened and was killed. I found small granulations scattered through both lungs, at some points aggregated; and in the right lung were two nodules, having a soft cheesy centre. The third guinea-pig, examined three months later, had no evidence of tubercle or other disease."

The only experiment upon a human subject was made by Drs. Demet, Pararky, and Zallories, of Syra, in Greece, who inoculated, with sputa from a phthisical patient, a man whose history afforded no suspicion of tubercle, and whose lungs were healthy, but who had gangrene due to femoral embolism, and who would not permit amputation. In three weeks, auscultation revealed evidences of disease at the right apex. Thirty-eight days after the inoculation, the man died from gangrene, when it was found that the upper right lobe had seventeen small tubercles and two granulations in the apex of the left lung.

In an inquiry into the transmissibility of phthisis, made by the Collective Investigation Committee in London, two hundred and sixty-one answers were received from physicians in family practice, affirming the proposition that phthisis may be communicated from the sick to the well; and evidence was given in proof of the statement. One hundred and ninety-two observers recorded cases where both husband and wife became phthisical, in one hundred and thirty cases there being no phthisis in the family of the one to whom the disease was thought to have been transmitted.

Some of these cases were very interesting. Dr. Spriggs of Great Bedford instanced the case of Miss R., aged 48, a dressmaker, who, living in rather a lonely cottage at C., Bedfordshire, had three ap-

prentices, young girls from seventeen to nineteen years of age, not related, from three adjoining villages, who took it in turn to remain in the house and sleep with her, each one week at a time. During their apprenticeship, Miss R. was taken with phthisis, of which she died. In less than two years afterwards, all three apprentices died of phthisis, although in the family-history of each no trace of phthisis existed; and the parents, brothers, and sisters of two are alive and well at this time.

Another interesting case was related by Mr. G. F. Blake of Mosely, Birmingham, in which a perfectly healthy child, with a family-history free from all trace of tubercle, was reported as becoming infected by a phthisical nurse, and having died with profuse hemoptysis, after the disease had run a rapid course.

Dr. Porter gives the following facts which have come under his own observation. He says, "In more than three hundred cases of phthisis, I have kept a record of the family-history, and find that fifty-one per cent of this number were of families in which some other case had occurred. The inquiry extended no farther than to first-cousins. Heretofore this would be accepted as evidence in favor of the heredity of phthisis, but I now believe that in many of these cases the disease was acquired by the carrying of the products of disease to a subject whose physical condition favored its reception and development. I recall the case of Mrs. L., in whose family was no trace of phthisis. Before her marriage, and for several years after, she was the ideal of a healthy woman. Two children were born. Her husband, a well-known city official, had phthisis. Her attendance upon him was constant, and for some months before his death she and the younger child were with him night and day. When called to attend him, I found that he had been substituting for the ordinary cuspidore a newspaper spread upon the floor at his bedside, and this would be loaded with sputa each morning. The case was rapid. The husband died, and within eighteen months Mrs. L. and the younger child also died from phthisis; while the elder daughter, who was comparatively little in the sick-room, still lives, and is well and strong. I have the notes of other instances almost as instructive, but this will suffice."

The author thinks that the disease may be conveyed in two principal ways, — first, by air carrying particles of disease into the respiratory tract; second, by food from infected sources, through the alimentary tract. In reference to these propositions, he says, "The first of these propositions is, I think, proven. Not only are the experiments and records here given powerful affirmations, but there is in the profession a steadily increasing belief in its truth which would require much more negative testimony than has yet been offered. I would not be misunderstood. I do not think that as yet we can sustain the statement that phthisis is contagious, — acquired by mere contact; or infectious, if the term be limited to imply a hidden subtile miasm communicating the disease: but I do hold that particles of matter from the site of disease in a phthisical patient may be carried, planted in suitable soil, and incite phthisis. I cannot think that all are liable to so acquire the disease. I would go further, and say that probably only those may so contract phthisis who have lowered their vitality through previous sickness or long watching in the sick-room, or those who have local congestion or inflammation in the respiratory tract. The fixation of a minute particle of dried sputum from a phthisical cavity, upon a point of irritation in the respiratory tract of a non-phthisical patient, may constitute an effective inoculation."

In reference to the second proposition, that phthisis may be caused by eating the flesh of tuberculous animals, or drinking the milk of tuberculous cows, he thinks this is to be received with the same limitations as the first; i.e., that there are conditions which favor the development already existing in the individual. He offers the following suggestions for the prevention of the extension of the disease: there should be frequent change of the atmosphere in the sick-room, complete disinfection of all clothing or vessels holding expectorated material; and the close confinement of any relative of, or attendant upon, a phthisical patient should be forbidden. He believes the day is at hand when the physician will recognize that it is as much his duty to examine the food that his patient eats, or the milk that is ordered for the sick child, as it is his province to see that the drugs he prescribes are pure and well compounded.

BOOK-REVIEWS.

The Nervous System and the Mind. By CHARLES MERCIER, M.B. London and New York, Macmillan. 8°.

THE announcement of the publication of this work raised great expectations, not alone because, in the interesting development through which the problem of the relations of body and mind is now passing, every promising contribution is certain to arouse great interest, but especially because any systematic treatise written somewhat from the psychological point of view is a great desideratum. The contents of such a work would be suggested by its function, which should be to serve as a propædeutic for the study of psychology, as well as to make clear to the general reader the position of modern science on this all-important question. Dr. Mercier's book does not fill this gap, nor was it intended to do so. His object is a simpler and a narrower one. Realizing the aversion of students of insanity to studies of the normal manifestations of mind, he is desirous of preparing for their special use a work that shall show how unscientific it is to attempt to restore a disordered mind to its normal functioning, without a precise and systematic knowledge of what those normal functions are. The object is certainly a most worthy one, and the more so because Dr. Mercier makes no secret of advocating the study of the philosophical aspects of mind on the part of medical students; not that he has any intentions of deluging them with metaphysics, but simply to impress them with the intimate relation of the problems with one aspect of which their specialty is concerned to the broad culture problems of humanity.

When we pass from the design to the execution, the work begins to be a disappointment. To enable the prospective reader of the work to judge of the validity of this verdict, a brief sketch of the contents of the book may be of service. The work contains three parts; the first treating of the physical and physiological functions of the nervous system, the second of its psychological functions, and the third of mind. Before starting upon the consideration of nervous function, we are gravely warned to bear well in mind the supreme and absolute distinction between mental and physical phenomena: the two are utterly heterogeneous, disparate, incommensurable; and all that we know is the parallelism that exists between them. With this distinction and this concomitance well impressed, the author is sanguine enough to believe that "the student will enter on the study of psychology with half his difficulties already surmounted." Under the head of the physical functions of nervous tissue, the cells and fibres are represented as molecules acted upon by a force, and the attempt is made, by the aid of more or less ingenious analogies, to demonstrate the possibility of the nervous system as we know it acting as the special agent of psychological functions. The most interesting and valuable portion of the book is undoubtedly that on the physiological functions of the nervous system; and much of this value is derived from the incorporation of Dr. Hughlings-Jackson's views on the interpretation of movements in terms of nervous discharges. The important distinction between 'central' and 'peripheral' movements is admirably described. On entering the psychological portion of the work, we feel at once the atmosphere that surrounds disciples of Mr. Herbert Spencer. As long as the general line of thought due to Mr. Spencer is applied to the evolution of conduct, or the ever-improving and more and more elaborate adaptation of organism to environment, the result is in more than one sense successful; but in the chapters on 'The Constitution of Mind,' on 'Thought,' on 'Feeling,' and in the three chapters on 'Classification of the Feelings,' the interest becomes a very formal and theoretical one, and amounts to little more than a digest of Spencer somewhat modified and elaborated. It will thus be seen that Dr. Mercier presumes a knowledge of the anatomy and physiology of the nervous system on the part of his readers, and wants to interest them in one particular aspect of their interpretation. This certainly does not appeal to the student of insanity. Not only does Dr. Mercier neglect to consider how very much of what he regards as most important is liable to be entirely modified by future research; but there is a vast and ever-increasing material from which it is being attempted by strictly scientific methods to build up a science of psychology that shall immediately appeal, by its intrinsic importance, to students of psychiatry, and of this development Dr. Mercier takes no