

no further than the circulatory system, it would throw a flood of light on the significance of otherwise obscure if not absolutely inexplicable phenomena. But it is to the nervous system that we must look for evidence which places the doctrine beyond cavil to a degree perhaps not equally clear in other parts of the economy.

When a mammal is poisoned by curare, by which the nervous influences normally reaching the tissues and regulating heat-production (and, as I believe, nutrition) are wholly or partially cut off, the mammal becomes virtually a cold-blooded animal. Its temperature rises and falls with that of the ambient air. This is one clear example of physiological reversion experimentally produced. It is, however, only one of many that might be instanced. It is well-known, and can be shown in the simplest manner, that when the head of a frog is removed, reflex action is more readily excited: the same applies to the removal of the cerebral lobes of the mammal. As Goltz has pointed out, one of the most remarkable results following removal of large portions of the cerebral lobes in the dogs which this experimenter kept under observation, is, as I can myself testify, the increase of reflex action. The animal becomes a sort of machine, which one may manipulate at will. A similar result follows in man when the higher centres of the cerebrum are rendered functionally inactive by disease or injury.

Now, in all these cases the animal loses its own peculiar character, and sinks to the level of some form lower in the scale. All will agree that the higher forms of true automatic (spontaneous) action in the physiological sense are dependent on the existence of the cerebrum. It follows, therefore, that the lower we pass in the scale of life, the more machine-like animals become.

Pathological reversion is most plainly illustrated by the results of hemorrhage into the cerebrum. Dr. Hughlings-Jackson has so well described the order and relation of the various events, that I shall here quote his own words in describing lesions of the cerebrum (*corpus striatum*), from hemorrhage:—

"It will be found that those parts suffer most and suffer longest which have the more voluntary uses. This is notorious of the arm and leg: the arm nearly always suffers more, and recovers later, than the leg. Of course, the distinction into complete and incomplete hemiplegia is artificial. There are all degrees of paralysis according to degrees of gravity of the lesion. But there is an order in which paralysis increases in increasing gravity of lesions. We observe that the graver the lesion, not only are the more voluntary parts (arm and leg) more paralyzed, but that the further spread in range is the paralysis, and the method of its spreading is from the more voluntary to the more automatic parts. Thus, neglecting very small clots, a considerable lesion paralyzes only the most voluntary movements of one side of the body, those of the face, arm, and leg, and these parts in degree according to their degree of voluntary use. A larger lesion not only causes a deeper and more permanent palsy of these three parts, but it leads also to implication of more automatic parts. In still larger lesions the palsy spreads to the most automatic parts of the body, even to parts supplied by ganglionic nerves. It produces stertor from palsy of the palate and palsy of the respiratory muscles and of the heart,—the palsy of respiration and of the heart showing itself chiefly in *slowness* of movement. There is also abasement of temperature." —REYNOLDS'S *System of Medicine*, vol. i.

I have intentionally quoted the exact words of this eminent investigator of the abnormalities of the nervous system constituting disease, so that their interpretation alone may rest with me.

It being granted that the lower we pass in the scale of animal life the more machine-like or automatic does the organism become, it will be clear, that, taking the various degrees or grades of paralysis as described above, we have likewise degrees of resemblance to lower forms; i.e., the graver the paralysis, the lower in the scale must we seek to find an animal comparable to man in this condition. The slowing of the heart and the lowering of the temperature are both modes of approach to the normal functional condition in cold-blooded animals.

When we add to this, or take by itself, paralysis of the muscles of the face, by which the expression peculiar to man is lost, we have a condition plainly like that in lower mammals, and, in extreme cases, even like that of the lower vertebrates, in which facial expression as determined by muscular action is minimal.

It must be conceded that the uneducated deaf-mute is in a condition mentally much nearer that of the higher mammals than is his uneducated fellow-man in possession of all his senses. But in aphasia, the result of disease or shock, there is in man plainly a marked reversion to a condition mentally resembling that in the 'dumb-brutes' about him.

In the case of the idiot we have an example of man in many respects inferior to the higher mammals.

But it is not my intention to treat the subject of psychological reversion in this paper. The subject is at once large, tempting, and, to my mind, furnishes evidence the most conclusive for the doctrine of descent with modification from lower forms as an explanation of man's nature.

One naturally looks about for an explanation of such remarkable facts as the order of muscular failure or paralysis as indicated in the paragraph quoted above. The entire brain may be separated from the medulla in a rabbit, and respiration still continue. The lower we descend in the animal scale, the more do we find the brain reduced to a mere repository for mechanisms adapted to regulate those processes constituting the so-called vegetative functions; but the question again and again recurs, 'Why in mammals, why in man, should the functions first to fail be those peculiar to them or to him, and not the reverse?'

The longer even in the lifetime of a single individual a certain form of muscular action has been practised, the less attention is required for its performance, the less voluntary, the more automatic it becomes. But would the duration of man's existence on this planet suffice to explain, on any system of gradual progression or functional improvement, the wonderful automatic action of all of those mechanisms essential to the maintenance of life?

The doctrine of descent renders the whole plain enough; and unless we adopt the view that man appeared suddenly and independently upon the scene, fully equipped for the battle of life, it seems but rational to assume that with all his departures, both by way of progress and retrogression, his functions are what they are by reason of such relationship as we are indicating. The morphologists have done much to account for the affinities of form or structure in the animal series: it remains for the physiologists to do their part in showing how the functions of the higher animals are related to the functions of the lower.

But once accepting this position, it is possible to explain phenomena following experiments on animals, and growing out of the experiments disease is producing, or, as I would prefer to say, the phenomena which are the deviations from the normal that constitute disease. Disease is no entity in itself, though we often use language which might lead to the belief that we so conceived of it.

When the normal adaptations to environment on which the very existence of an animal depends are disturbed, what more natural than that there should be a return to a functional condition prevalent in some ancestral group, or common to a host of such groups, as the case may be?

T. WESLEY MILLS.

BOOK-REVIEWS.

Animal Magnetism. By ALFRED BINET and CHARLES FÉRÉ. (Internat. Scient. Series.) New York, Appleton. 12°.

THE nation that brought forth Mesmer, with his glittering display of charlatanry, has well atoned for this injury by bringing the study of hypnotism into general scientific recognition, and developing with a remarkable activity our knowledge of this obscure region of the human mind. Nowhere are so many men of science practically engaged in the study of hypnotic phenomena in all their various manifestations, nowhere are subjects so plentiful or so interesting, nowhere do we find so vast or so sound and constantly increasing a literature devoted to this field, nowhere else a journal devoted exclusively to the study of hypnotism, as in France. Although much that has been developed there is doubtless destined to be revised or rejected, yet the work is eminently scientific, and with few exceptions the workers have never deserted the field of painstaking, methodic study for the temptation of enlarging upon remarkable facts, liable to attract the popular imagination. The admission of a work on this subject into the International Scientific Series is therefore eminently fitting, and it is also right that the work thus honored should come from Paris, and more particularly

from two pupils of Charcot, to whom, more than to any other single person, the admission of hypnotism as an accredited scientific proceeding is due.

The work itself is very well arranged, and introduces for the first time to English readers a fairly complete account of the modern studies in hypnotism. Our literature in this field is mostly concerned with the proofs of the genuineness of the states and accounts of remarkable performances, to the exclusion of the systematic study of the symptoms. The opening chapters are devoted to a concise history of hypnotism since Mesmer. The fate of this pretentious adventurer is full of interest. Mesmer appeared with his gigantic presumption, and offered a series of dogmatic propositions about the magnetic fluid coursing through the universe and influencing men. He next demonstrated to the satisfaction of the wealthy and frivolous Parisians the curative powers of this fluid. And his success was unparalleled; but, like that of most adventurers, his downfall was equally hurried. In 1784 a commission, including among its members Franklin, Bailly, and Lavoisier, was appointed to examine into the phenomena; and with commendable good sense they demonstrated the utter baselessness of Mesmer's pretensions, and ascribed all that occurred to the action of the imagination in nervously disposed individuals. Again and again is this same process repeated. A bold experimenter claims to have performed some remarkable feat; a commission is appointed, finds the pretension unwarranted, and dismisses the whole topic. A valuable prize was for several years open for any one who could read with a bandage across his eyes, as several subjects claimed to do, but no one ever successfully passed the tests. At last the scientific men were forced to the conclusion, that, while the more remarkable of the phenomena were probably exaggerated, enough remained to merit a real investigation, and that to refer every thing to the action of the imagination was no real explanation at all. This recognition was all that was necessary to give the impulse to the study of hypnotism as a more or less morbid manifestation of the nervous system.

The next chapters are devoted to the methods of producing the several kinds of hypnosis and the symptoms of the several stages. Here the authors follow Charcot's well-known three states, — lethargy, catalepsy, and somnambulism. These states are marked off from one another by distinct physical symptoms, and, though we have no satisfactory explanation of the reason why the raising or closing of the eye should cause certain subjects to pass from one to the other, yet the phenomena seem well enough established to be accepted as empirical facts. Again, the stages are found pure and typical only in hysterical hypnosis; and many subjects exhibit only one or two stages, and the symptoms manifested frequently diverge from what is here considered typical. The account of the symptoms is largely restricted to the more purely physical ones, which, though less striking, are much more convincing and valuable to the scientist. The writings of the pulse and the respiration, and of the curve of muscular fatigue, are figured, and speak more plainly than pages of description.

The psychological process most admirably illustrated by hypnotic subjects is that of suggestion, and to this Binet and Féré wisely devote a liberal portion of their pages. This process is simply unusually active in the hypnotic subject: it is exemplified daily in the influence of a strong-willed person over a weaker, of the teacher over the scholar; in short, "we have only to glance at social relations in order to see that individuals fall into two categories, — the leaders and the led; that is, the givers and the recipients of suggestions." These suggestions can be taken up by any of the senses, and, in brief, suggestion may be defined as the execution of an act through the intervention of the psychic faculties, the original impulse coming from another individual. One school of students of hypnotism (often known as the School of Nancy) regard all the facts observed in hypnotic states as due to suggestion, conscious or unconscious; and their explanation of such phenomena as the action of a magnet in transferring sensations from one side to the other, of the supposed action of drugs at a distance, of mind-reading, is that these effects are due to the unconscious suggestion of the results by the operator. The hypnotic state makes the subject keenly on the alert for the remotest hint; and many cases where the expected has been guessed at with a remarkable shrewdness, far beyond the capabilities of the subject in a normal condition, are on

record. The Paris school, on the other hand, regard suggestion as applicable to only a portion of the phenomena, and hold that certain purely physical symptoms are produced with which consciousness has nothing to do. For example: the methods of inducing sleep by passes, intense fixation, etc., the Nancy school regard as devices for impressing the mind of the subject with the idea that he is to be hypnotized, and that the same results follow from any signal to which the subject is accustomed; while the Paris school regard these physical manœuvres as of peculiar efficiency and influence upon the nervous system. Both schools agree that the process of suggestion is the key to a majority of the more striking hypnotic phenomena, and that a knowledge of the possibilities of suggestion is indispensable to every student of what is now termed 'psychic research.'

The chapter dealing with hypnotic hallucinations is full of interest. The instances of unilateral hallucinations, in which only one-half of the body, one eye, one ear, or whatever it may be, has responded to a suggestion, lead one to connect with them the theories regarding the action of the two halves of the brain. An important part of the investigation concerns itself with the genuineness of these hallucinations, for this is the field where simulation is to be guarded against at every step. Binet and Féré have elaborated a series of tests, which leave no doubt as to the conclusion that these induced hallucinations are real in every sense. If they are visual, as most of them are, they are doubled and refracted if a prism be interposed between the eyes of the subject and the imaginary image; the image is enlarged or grows smaller, as the right or the wrong end of an opera-glass is put to the subject's eyes; and so on. Another interesting type of hallucination occurs when the subject conjures up from a blank card a picture or portrait at the command of the operator. If the card be inverted, the supposed picture is seen upside-down: if another precisely similar blank card is substituted, the change is instantly detected, for the imaginary picture vanishes. The explanation is, that the abnormally keen sight of the subject has detected upon the apparently uniform surface some little mark, some trifling irregularity, and that this is sufficient to arouse the suggested image. This view is supported, to mention one fact of many, by the observation that at a great distance the subject no longer distinguishes between the card with which her hallucination was connected and other blank cards, while, if an opera-glass be given her, the image is again aroused when the right card is shown.

Under the term 'psychic paralysis,' the authors bring together a most interesting series of facts, which would perhaps be more fittingly viewed as psychic inhibitions. The type of the psychic process here specified is easily made clear. A subject is given the suggestion that a certain person in the room is invisible. From that moment on, she does not see him. If he places himself in her way, she tries to avoid him, but is sorely perplexed to understand the nature of the obstacle. A hat placed upon the gentleman's head is to her mysteriously suspended in the air, and so on. Now, in all such processes the subject sees every thing else: she has not been made blind, and the image of the invisible individual striking upon her retina makes her see him, in a sense. But the orders have been issued from the cortex that when such and such an image is impressed upon the retina, it shall not be converted into a sensation. While consciousness is at home, it is not at home to that particular sensation; or, as another writer has expressed it, it is the process we make use of when we cut a friend in the street. It is not that we do not see him, but that we make ourselves believe as far as possible that we do not see him. This process (though it is not so original with the authors as they claim) is sure to yield interesting results from future study.

The final chapters of the work deal with the question of the therapeutic value of hypnotism, its relation to the problems of responsibility, and so on. On all these topics the authors hold very sound opinions, and are as keenly alive to the dangers and possible abuses of hypnotism as they are to its importance as a department of experimental psychology or as a curative agent.

The volume can be warmly recommended to all anxious to acquire a familiarity with the most truly scientific work in this field, although it represents only one of many equally able productions of the French school. It should also be remembered that the authors

are to some extent partisans of a definite school of hypnotism, and that some of the phenomena upon which they lay stress would be otherwise interpreted by other workers, or even entirely discredited. About nothing is this caution more necessary than the results these authors describe as due to the action of the magnet. As long as it has not been proved that the normal nervous system is to the slightest degree subject to magnetic influence, it seems premature to have it play so great a part in the observation of hysterical hypnotics; and the more so, as the same results have been obtained by suggestion; and, in so far as this has been ruled out, the results have failed to follow with other experimenters.

Lectures on Bacteria. 2d ed. Tr. by H. E. F. Garnsey. Rev. by I. B. Balfour. New York, Macmillan. 12°. \$1.50.

THIS book is a translation of De Bary's 'Vorlesungen über Bacterien,' and, as Dr. Balfour states in his preface, has been prepared because there is at present no book in English which gives in like manner a general view of the subject of bacteria. It sets forth the known facts in the life of bacteria in their connection with those with which we are acquainted in other branches of natural history. The second edition of De Bary's lectures appeared in October, 1886; so that we have the researches into this abstruse field of science brought down to a very recent date. In the introductory chapter the author considers the position which bacteria occupy in the vegetable kingdom among the fission-fungi or *Schizomycetes*, and their structure. He then defines the meaning of the terms 'coccus,' 'bacterium,' and 'spirillum.' In speaking of these three forms, he says that they are so exactly represented by a billiard-ball, a lead-pencil, and a corkscrew, that no one requires for his instruction the costly models which are offered for sale.

The course of development of bacteria, and the distinction between the endosporous and arthrosporous groups, next receive attention. From this the author passes on to the consideration of the much-mooted question of whether there are specifically distinct forms, species of bacteria, and, if so, how many such species can be determined. In treating of this interesting topic, he says that species are determined by the course of development, and defines the term 'species' as the sum-total of the separate individuals and generations which, during the time afforded for observation, exhibit the same periodically repeated course of development within certain empirically determined limits of variation. In the list of those who believe that the bacteria may be distinguished into species, are Leeuwenhoeck, their discoverer, Ehrenberg, and Cohn. Among those who deny this, and who consider that the observed forms proceed alternately from one another, the one being converted into the other with a change in the conditions of life, are Billroth, who, in a publication issued in 1874, included all the many and various forms which he had examined in one species, which he named *Coccobacteria septica*; and Nägeli, who has supported the same views since 1877. Nägeli says that he finds no necessity for separating the thousands of bacterium-forms even into two species, but that it would be rash to speak decidedly on a subject that is so imperfectly explored. But he also says, that, if his view is correct, the same species, in the course of generations, assumes a variety of morphologically and physiologically dissimilar forms one after another, which, in the course of years and decades of years, at one time turn milk sour, at another give rise to butyric acid in sauerkraut, or to ropiness in wine, or to putrefaction in albumen, or decompose urine, or impart a red stain to food-material containing starch, or produce typhus, relapsing-fever, cholera, or malarial-fever. In commenting on this view of Nägeli's, De Bary truly says that our practical interests require that we should obtain a decided answer to the question of species; for it certainly is not a matter of indifference in medical practice, for example, whether a bacterium which is everywhere present in sour milk or in other objects of food, but without being injurious to health, is capable or not of being changed at any moment into a form which produces typhus or cholera. The scientific interest demands that the question should be set at rest. The opinion to which De Bary himself comes, in reference to this important question, is that it may safely be maintained that continued investigation has at length arrived at the decision that there is no difference, as regards the existence of species and their determination, between this and any other portion of the domain of natural

history, and that species may be distinguished provided the course of development is followed with sufficient attention. The origin and distribution of bacteria, their vegetative processes, the effects of temperature and the presence or absence of moisture upon them, and the subjects of culture, disinfection, and antisepsis, are discussed by the author, but lack of space prevents us from following him into these subjects in detail.

One of the most interesting chapters in the book is that which treats of the causal connection of parasitic bacteria with infectious diseases, especially in warm-blooded animals. De Bary regards as proved the causal connection between the *Spirochæte obermeieri* and relapsing-fever, Koch's bacillus and tuberculosis, Neisser's gonococcus and gonorrhœa, and Koch's spirillum and Asiatic cholera. Among the diseases due to the action of bacteria, he reckons also traumatic infectious diseases, affections incident to child-bearing, and others connected with the formation of groups of ulcers, abscesses, and boils. He does not think that we have any precise determination of the nature of the contagium or miasma virum of malaria. The relation of bacteria to typhoid-fever and diphtheria in men, he regards as uncertain, notwithstanding Goffky's and Löffler's model investigations. The concluding chapter of De Bary's admirable *résumé* is concerned with the discussion of the diseases caused by bacteria in the lower animals and in plants, while this is followed by a conspectus of the literature of the subject, and notes on the text. The whole volume is admirably arranged, and we know of no book which gives so concise and at the same time satisfactory an account of bacteria as the one before us. It is well translated; and its revision by Dr. Balfour, who is professor of botany in the University of Oxford, is a sufficient guaranty of its scientific accuracy.

Catalogue of the Pedagogical Library, Philadelphia. Philadelphia, Board of Education. 12°.

WHEN Superintendent MacAlister went to Philadelphia from Milwaukee four or five years ago, he saw and felt the need of having at his command the best authorities on the history, science, and art of education. The Board of Education appreciated the need, and by liberal appropriations it has been made possible for Mr. MacAlister to get together the volumes for which he has now printed a catalogue. Naturally, he has only selected from the field of educational literature, and has made no attempts to cover it in all its extensiveness. What he has gotten together is a good working pedagogical library, and "it is believed that the selection made furnishes the essentials for a pretty thorough study of the history and theory of education in the past, as well as ample materials for dealing with the living questions of our own time." Therefore it is that this catalogue, while referring to this one collection only, really serves as a carefully selected bibliography of pedagogics. In this respect it is far more useful than that of Messrs. Hall and Mansfield, published a year or two ago. That is too diffuse to be really useful, and it is disfigured by hundreds of mistakes and typographical errors. We trust that professor MacAlister has printed a sufficiently large edition of his catalogue to permit its general sale.

Natural Resources of the United States. By J. H. PATTON. New York, Appleton. 12°.

THE present volume is a concise review of the resources of the United States, compiled from the publications of the various National and State departments, and from private information obtained from the State governments. Therefore the data are presumably, as a rule, reliable; and as the book deals not only with the mineral resources, but comprises others also, it will be found handy as a brief review of the whole subject. 324 of the 523 pages of the book are taken up by a report of the mineral resources, on which D. T. Day treats in his annual summaries. This part is followed by notes on mineral springs and health resorts. The following sections, dealing with the vegetable products of the United States, grain, fibre plants, and timber, are very superficial; that on grasses, such as are the basis of American stock-raising, is even more so, the whole subject being treated in nine pages.

In the book we find a considerable number of remarks on physical geography which show that the author's knowledge of this subject is not very extensive. The authorities he quotes for his views