same behavior marked the spinning of the cushion, in the middle of which the eggs had been deposited. The ideas of the observer as to the cocooning habits of Lycosa were very much confused by an observation so opposed to the universal experience. Upon resuming the study after the lapse of an hour and a half, he was once more assured of being right by the sight of a round silken ball dangling from the apex of the spider's abdomen, held fast by a short thread to the spinnerets. The cushion, however, had disappeared. The mystery, as it had seemed, was solved: the lycosid, after having placed her eggs in the centre of the silken cushion, and covered them over, had gathered up the edges, and so united and rolled them as to make the normal globular cocoon of her genus, which she at once tucked under her abdomen in the usual way. This was a most interesting observation, which Dr. McCook believed had not before been made. The manner of fabrication of the cocoon of Lycosa had been heretofore unknown to him, and, by reason of her subterranean habit, the opportunity to observe it was of rare occurrence. He had often wondered how the round egg-ball was put together, and the mechanical ingenuity and simplicity of the method were now apparent. The period consumed in the whole act of cocooning was less than four hours: the act of ovipositing took less than half an hour. Shortly after the egg-sac was finished, the mother cut her way out of the silken cover. She had evidently thus secluded herself for the purpose of spinning her cocoon.

Dr. McCook also alluded to another interesting fact in the life-history of the Lycosa, which had been brought to his attention by Mr. Alan Gentry. A slab of ice having been cut from the frozen surface of a pond about eight or ten feet from the bank, several spiders were observed running about in the water. They were passing underneath the surface, between certain water-plants. It is remarkable to find these creatures thus living in full health and activity, in midwinter, within the waters of a frozen pond, and so far from the bank, in which the burrows of their congeners are commonly found. It has been believed heretofore, and doubtless it is generally true, that the lycosids winter in deep burrows in the ground, sealed up tightly to maintain a higher temperature.

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## *CALDERWOOD'S MIND AND BRAIN.*

*The relations of mind and brain.* By HENRY CALDERWOOD, LL.D., professor of moral philosophy, University of Edinburgh. Second edition. London, *Macmillan & Co.*, 1884. 20 + 527 p. 8°.

IT is a striking comment upon the complete change of stand-point assumed by psychologists, to find an eminent Scotch metaphysician giving up one-half of a work upon the mind to the consideration of the anatomy and physiology of the brain. That he is in accord with the prevailing tone of thought, both among general readers and among special students, is proved by the fact that a second edition of this work has been demanded.

Dr. Calderwood presents the results of recent investigation in two sciences, — physiology and psychology, both animal and human; and his work is in the main successful, because the author possesses the power of impartial judgment, which enables him to admit all the evidence before pronouncing a decision, and also the power of making a clear statement of both scientific facts and philosophical problems. Those who desire to ascertain the kind of work which is being done in the comparatively new department of physiological psychology will find the book of great service. The subject "has to do with the foundation questions for all mental philosophy; for current theories concerning the origin and development of life on the earth, and speculation affecting the order and government of the universe as a whole, have more or less bearing upon it" (p. 9).

In the earlier chapters, the author succeeds in giving a clear and interesting account of a dry and complex subject, — the comparative anatomy of the nervous system. He then proceeds to the physiology of its various parts, devoting particular attention to the question of the localization of functions in the brain. The existence of definite areas upon the surface of the brain, whose irritation produces motion of the limbs, or sensations, according to the area irritated, and whose destruction produces a loss of the power of motion or sensation in the corresponding organs, is no longer a matter of question. By confining his attention to the researches of Ferrier, and by omitting the equally important and more recent conclusions of Munk of Berlin, Dr. Calderwood has failed to give a complete review of the physiological facts at present known. Had he ascertained the position reached by pathologists from the study of cases of limited centres of disease in the brain of man, he would have admitted more freely the existence of localizable areas in the human cerebrum. In his chapter on brain-disorders, he omits to mention a large class of cases which have a bearing on this subject; viz., cases in which a small destruction of brain-substance has been accompanied by a loss of one function, the function affected depending upon the situation of the disease. In this connection, Dr. Calderwood repeats a statement of Sir Charles Bell, that "whole masses of brain in man may be destroyed without any immediate influence upon mind" (p. 51). As a matter of fact, careful examination of such cases will rarely fail to demonstrate the pres-

ence of mental symptoms, which may be summarized as a loss of self-control and consequent change of character. In spite of these defects, the author's statement of the subject of localization is the best that can be found outside of physiological text-books.

In an interesting chapter upon the comparison of structure and functions of the brains of various animals, the conclusion is reached that mental activity is not proportionate to complexity of brain-development. He says, "The state of the case is this: the dog, with a brain less elaborate in its convolutions, shows a higher degree of intelligence; the horse, with a more ample and complicated series of foldings in the convolutions, shows less intelligence. Advance in intelligence, and advance in complexity of brain-structure, do not keep pace with each other" (p. 148). He claims, on the other hand, that "large development of brain, apart from marked development of sensory apparatus, is prominently connected with the functions of the motor side of the nerve system" (p. 259). These conclusions serve to introduce his theory of animal intelligence, which is the new feature of this edition.

Animal intelligence, according to Dr. Calderwood, is simply 'sensori-motor activity.' It is reflex and automatic action. It is the same in kind, from the simple act of the mollusk in drawing in and expelling currents of water, up to many of the most highly complex and coördinated acts of man. The nerve system, in all cases, may be resolved into a typical form, consisting of two sets of fibres (one sensory, one motor) meeting in a central organ, which may be a single cell of the spinal cord, or a complex assemblage of bodies crowned by the cerebrum. Motion starting at the periphery, carried along the sensory nerve, is communicated to the nerve-centre, there modified, and thence transmitted along the motor fibres, outward to the muscle, where it produces motion. This is sensori-motor activity. It is discriminative and purposive. But from these characteristics it is a mistake to argue intelligence. "Purposive action nowhere necessarily involves intelligence" (p. 205). The intelligence of animals, thus viewed, is the antithesis of intelligence in man, which has other characteristics. The degree of intelligence in animals depends upon the degree of perfection in their sensory organs. The great intelligence of the ant is due to its fine organ of touch, in the antennae; that of the chick, to its power of vision; that of the dog, to its keen sense of smell, combined with its moderately developed sense of sight, etc. He concludes, that, in the whole range of animal life, power of discrimination is largely determined by the range of sensibility belonging to external organs of sense. "The so-called intelligence of animals is nothing more than the purposive action of mechanical apparatus." Their memory is mechanical, and does not imply true intelligence, as Huxley has long taught. The degree of intelligence in animals is due less to the development of inherent powers by natural selection than to their training by man. "The intelligence of the dog is a distinct product of thousands of years of human training. . . . Accordingly the intelligence of the dog is withdrawn from available evidence as to natural evolution of intelligence in the world. . . . This is not intended as a denial of a law of evolution operating within living organism, but it materially affects the structure of the theory of evolution by natural selection, taken as a whole" (pp. 250, 251). "Evolution of organism and of intelligence do not so harmonize that progress in the one can be a pure index to progress in the other" (p. 261). From the study of animal actions, Dr. Calderwood concludes that no animal interprets its own sensory experience, or develops its own nature, or improves that of its own species, by reflective exercise. "All that is concerned with higher intelligence, whose natural function it is to seek the interpretation of sensory impressions, and to govern activity on principles of conduct superior to the impulses of sensory apparatus, lies quite beyond the region of investigation hitherto explored. . . . Mind does not find a place within the area of nerve apparatus" (p. 288). Mind is revealed to us by consciousness. "Consciousness assures us of the existence of non-organic elements connected with sensory experience: viz., 1°, interpretation of impressions made on the sensory apparatus; 2°, inference by comparison of past experience with present; 3°, synthesis of knowledge by use of forms and materials belonging to mind itself. . . . These indicate the presence in human life of an intelligent nature distinct from organism, as it is different from that which we designate 'animal intelligence'" (p. 308).

This view of the subject deserves consideration, however much we may differ from the author. It is evident that Dr. Calderwood believes that there is no relation between brain and mind as he defines the latter. But being unable to ignore the resemblance between the intelligent action of animals and of man, or to pass by the many forms of interaction of mind and body as described in a subsequent

chapter, he adopts the automatic theory for the explanation of animal intelligence, and carries it farther into the range of human action than any psychologist has hitherto ventured to do.

His theory of the dependence of mental activity upon the degree of perfection of sensory organs in animals is ingenious, but his own statement of the typical form and function of the sensori-motor system is opposed to it. That system is a double one, and no amount of development in one half can compensate for a lack of development in the other half. However fine the structure of a sensory organ, it is useless, unless a corresponding development has occurred in its governing centre and executive motor apparatus. An example in point is the olfactory apparatus in man, which is a beautiful piece of mechanism, without a correspondingly complex central organ, — a survival of a formerly valuable sense, at present almost useless. Nor can Dr. Calderwood's conclusion that the complexity of brain structure is proportionate to muscular development be admitted in a causal connection. There is, doubtless, a parallelism. But the one settled fact of brain physiology is, that, through the entire range of vertebrate animals, but two convolutions of the brain are the seat of motor functions. The other convolutions have nothing to do with governing muscular action; and it is inconceivable that they have developed simply to keep pace with the two motor convolutions which form but a small fraction of the entire brain. From a comparison of the habits of the dog and the horse, and of the dog and the ape, Dr. Calderwood concludes that the dog is a more intelligent animal than the others. He finds the dog's brain a comparatively simple structure, and then states his wide generalization that complexity of structure has no relation to intelligence. But a few pages farther on he takes care to show that the dog's intelligence is due to a thousand years of man's training. Is it not possible that the horse and ape, under the same conditions, might have made even a greater progress than the dog has made? And as long as this possibility remains, does it not invalidate the generalization?

It is impossible, in a limited space, to follow the author in all his arguments. It is only necessary to call the attention of readers to the fact that Dr. Calderwood's explanations of the facts he so clearly states, are not the only ones to be considered. The chief defect in the entire discussion of animal intelligence is the lack of discrimination between various grades of reflex action. There are lower and higher reflexes, simple and complex reflexes, according as the reflex centre excited lies farther from or nearer to the cortex of the brain. Each higher reflex centre not only possesses a power of its own, but also exerts an inhibitory action upon those below it. It is this inhibitory action which makes reflex action purposive. A complex reflex centre receives numerous sensory impulses, compares them, and selects the proper response. If we admit that the cortex can act automatically, we must admit, that, in such automatic action there, the centres receive, group, distinguish, and co-ordinate many various impulses arriving in them from different organs at once, and respond by sending out a complex and co-ordinated impulse to the muscles. An example is the balancing of the somnambulist as he walks a narrow bridge. This is very different from the simpler reflex which draws back a finger from the flame. But when this complex reflex is analyzed, it is found to contain many of the elements which Dr. Calderwood would limit to conscious intelligence of man. In the anecdotes given on pp. 236 and 243 we have examples of a 'sensori-motor activity,' which was certainly the result of the animal's interpreting its own former sensory experience, and comparing past with present acts with a view to the regulation of conduct. In a word, we have in these animals' actions a proof of consciousness and intelligence in the strict sense in which the author applies these terms. 'Mind' must be given a place within the area of nerve apparatus. It may be admitted that we have no proof of the existence of consciousness in others; but, if we argue consciousness from action, we must include the actions of animals as well as of our friends. We are reduced to one of two alternatives: either much that Dr. Calderwood advances as evidence of mind in man is really evidence of a more complex sensori-motor activity, or much that he explains away in animals is true intelligence. There is such a continuity of development, both in organism and in intelligence, that any attempt to draw a boundary-line between sensori-motor activity and intelligence at once raises objections on both sides, — a conclusive proof that we are not yet able to draw the boundary.

We do not care to follow the author through the more psychological part of his work, as his explanations lose much of their force in view of these objections. It is gradually becoming evident that a rich field for cultivation in psychology lies within the domain of

pathology; that the study of diseases of the brain throws much light upon normal mental processes. In a future edition we hope to find a more thorough investigation of the facts of pathology. Dr. Calderwood has made a distinct advance from the old position, which limited the study of psychology to the facts presented by self-consciousness. In this direction there is room for farther advance. The candor of the author, his critical acumen, and his freedom from irritation in stating or examining opposing views, fit him for the work he is doing in an eminent degree. His style is finished and attractive. The book, with its numerous illustrations, is pleasant reading, and will doubtless reach a third edition. It will be of interest and of service to those who, from lack of familiarity with German, are unable to read the superior work of Wundt, *Grundzüge der physiologischen-psychologie.*

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## *THE GOVERNMENT AGRICULTURAL REPORT.*

*Report of the commissioner of agriculture for the year 1883.* Washington, *Government printing-office*, 1883. 496 p., 11 pl. 8°.

THE present volume is the twenty-third, we believe, of a series eminently well qualified to excite the curiosity of a scientific inquirer. It must, in truth, be admitted that the volumes of this series are less peculiar, on the whole, than their immediate predecessors, the so-called agricultural portion of the old patent-office reports; but the new dispensation has been odd enough, and it will doubtless be freely commented upon by future historians on this account. Taking the volumes one with another, the investigator will find in them a considerable mass of 'statistics' at which he may well look askance; divers reports 'of divisions' or of specialists, of every conceivable grade of mediocrity, illumined at rare intervals by glints of sense or strength; while occasionally he will come across papers of real excellence. In addition to the official lucubrations, there has generally been published a considerable bulk of twaddle, pure and simple, obtained 'by favor of representative farmers,' and published, evidently, for the purpose of pleasing the writers. Such men are, in truth, representative specimens of the class which finds comfort and satisfaction on seeing its name in print. People of this sort have always hung like an incubus on the agricultural newspapers of the country, in spite of all the asphyxiative devices known to editors; but it is specially offensive to behold them emblazoned on the very escutcheon of the greatest nation on earth, — on the facet, namely, presented by one of the most conspicuous of the governmental establishments. It is but mild reproof to say that the department of agriculture has, from the beginning, kept well behind and below the standards of science and knowledge actually existent in the country. With regard to the matter of statistics, it is gratifying as well as in some sort amusing, to be assured officially that they are now valuable. The commissioner says (p. 9), "The division of statistics has never done better work than in the past year. It has advanced its standing for accuracy and breadth in this and in foreign countries. *Its aim is in direct contrast with the prevalent haste and superficiality of the day, towards completeness and fulness of statement, a true parallelism in comparison, and legitimacy in deduction,*" — a sentiment so elevated that we are constrained to print it in italics.

So long as men are men, there will doubtless be found two opposing camps to debate the question of the barren fig-tree. There will be those to cry, 'How long, O Lord, how long?' and to pray for means of radical destruction; while others of sanguine mood, together with all those who find comfort and shelter in the shadow which the tree casts, will insist on the continuance of processes of manuring, watering, grafting, caprificating, tinkering, and cosseting, even to the end of time. Thanks to such fostering care, the department of agriculture continues to live its life; and it is but fair to say, that, for the year now in question, some of its twigs or branches do give evidence of a certain vigor and comeliness. The reports of the entomologists in particular, and of the veterinarians, are noteworthy and praiseworthy. Professor Riley's report shows, as usual, the hand of a master in all its parts. Some of the experimental work relating to the destruction of insects will be found interesting by not a few general readers, more especially the results of trials of emulsions of petroleum used as insecticides. The discovery that petroleum can be applied in this way is manifestly one of very great practical importance for farmers, gardeners, and vine-dressers. Professor Packard's report on the causes of destruction of evergreen forests in northern New England and New York is full of interest and instruction. It is an excellent example of the manner in which technical scientific reports should be written.

Dr. Salmon's report on the work and plans of the veterinarians is indicative of scientific