LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Flying-Machines.

FROM the age of mythology to the present time man has attempted to unravel the mysteries of flight, and to imitate the bird in its easy conquest of the ocean above us. The study of this question has been left to cranks or semi-intelligent dabblers in science. One of the latest instances was that of Mr. Lancaster, who was treated rather coolly at Buffalo at the meeting of the American Association in 1886. An offer of a hundred dollars was made for the display of a model that would meet his claims, but it is needless to add that the money did not change hands. Only last week, however, the usual rule was broken, as Professor Langley, who has a world-wide reputation as an eminent scientist, entered the lists as a champion of the idea that a flying-machine is practicable. We have been somewhat disappointed, however, on looking carefully into his scheme, and very much fear that he has only succeeded in more perfectly proving the impracticability of a direct imitation of the bird.

Professor Langley illustrates his views by drawing a picture of a man walking upon a series of cakes of ice, each one of which is so small that he would sink if he does not pass very quickly from one to the next. It is plain that if the man is given no assistance except a violent up-and-down movement of the arms, in imitation of a bird's wings, he would go down if he stood still; but suppose he had a pole resting on the bottom, it is easy to see that by exerting a slight pressure upon the pole he would be sustained by the cake of ice. We may well believe that the exertion required to support a part of one's weight in this manner would be very much less than that required to pass quickly from cake to cake. The same reasoning may be applied to a heavy bird standing upon ice: it may run from cake to cake with wings closed, or it may stand still and gently support a part of its weight by a use of its wings. In the latter case the exertion required would be much less than in the former. This idea of adaptability would seem to lie at the bottom of this whole subject.

If we had a balloon weighing two hundred pounds, and inflated, it would rise till it reached an equilibrium at two thousand feet, say. The exertion required to move it a limited distance in any direction, down or up, or sidewise, would be exactly the same. If, now, we empty the gas, we have changed all the conditions of flotation; and the covering, if compacted, at once falls with great speed to the earth. To keep up this ball of cloth by a blast of air would require the expenditure of a great deal of energy; and in like manner, if we undertook to transport it horizontally by a blast of air, and keep it from falling, it would require still more force: in fact, it is evident that a horizontal blast could not keep the body from falling, no matter what its force. On the other hand, we may support the ball by a cord, and then we can move it in any direction a short distance horizontally with the very slightest exertion.

Suppose the cloth of the balloon, instead of being compacted, could be stretched in a plane surface. The velocity of its fall would be much diminished; but to keep up a blast of air from outside to support this plane, or to move it horizontally, would require the expenditure of much more energy than before. Let us change the condition and apply the force directly to the plane, inclining it at the same time with the horizontal. It is evident that with an angle of 45° the resistance from the air would be large as compared with the skin-friction; but if the angle is made very small, say one degree, the total resistance at a much higher velocity would be the same as before. It would seem, however, that a plane under these conditions could be balanced only with the greatest difficulty; and, as Professor Langley has said, the steering and propelling apparatus have yet to be devised. It is easy to see that, after all, these three points are really the essentials; and if it can be shown that a plane, which is so very different from the bird in its form and adaptation to the air, is really essential to a solution of the problem, then we may say that it has been conclusively proved that a flying-machine pure and simple cannot be constructed. We may hope to vie with the bird, but we can never go beyond it in its general form, adaptability, and mode of action in flight.

Professor Langley thinks we can go fast much more easily than we can go slow. It is evident, however, that a bird does not support itself by going fast, for we have examples of its soaring and remaining stationary for quite a long time. It would seem, also, that the practical solution of the problem would be rendered much more difficult at great velocities. As a matter of fact, it would be much easier to go slow than fast; for the propeller, ballast, and other parts would have to be increased in such a ratio as the velocity increased, that the resistance of the air would become enormous, amounting, as it does, to forty pounds per square foot at a hundred miles per hour.

Professor Le Conte of San Francisco, in a recent number of the *Popular Science Monthly*, has summarized the arguments against flying-machines, and his position certainly seems impregnable. These arguments may be briefly paraphrased.

1. We can never construct a mode of utilizing fuel or a source of energy which shall equal the bird.

2 We can never build a machine which shall have such perfect adaptation to flight in all its parts as the bird has.

3. There is a limit of weight, probably fifty pounds, beyond which a bird cannot fly. Obviously a self-raising, self-supporting, and self-propelling flying-machine to carry a man is impossible.

H. A. HAZEN.

Washington, D.C., April 25.

Protection from Lightning.

I RECEIVED an invitation from you some time ago to criticise your theory of lightning, and since then I have been rolling the idea about in my mind to look at the lightning longitudinally, transversely, and askance. It was so novel that I did not quite get the idea at first reading, and it was so different from my already partly well defined views that I had to think about it, which accounts for my delay in replying. Some of your arguments are very strong; say, the observations of the stroke upon the steeple, etc., supposing that to be well authenticated. I don't believe I am well prepared to deny but you may have the solution, and I should be glad to know that you had.

Now, does not your theory imply that the first step in the transferrence of electric energy from an electrified cloud is to produce a stress in the ether between the cloud and another adjacent body, say the nearest, either cloud or earth; that the energy is therefore in the ether until the discharge takes place, and the discharge is the unloading the ether in a direction at right angles with the direction of the stress? The electricity, therefore, is not transferred from cloud to earth or from earth to cloud, but is only a kind of static collapse. Perhaps this does not quite represent your idea.

A. E. DOLBEAR.

College Hill, Mass., April 19.

BOOK-REVIEWS.

Outlines of Physiological Psychology. By GEORGE TRUMBULL LADD. NEW YORK, Scribner.

PROFESSOR LADD'S larger work, "The Elements of Physiological Psychology," is so well known to all students of this topic that this abridgment of the larger work hardly calls for extended notice. The scope of the work and the manner of treatment are essentially similar to those of the "Elements," and its handier form will undoubtedly make it a welcome volume to a large circle of students. It is distinctly the only work in English that pays due attention to the experimental work of foreign psychologists; and American readers, no matter what their points of agreement or disagreement with Professor Ladd's views may be, should be distinctly grateful for this useful service. One cannot repress the wish, however, that, while so much pains and ability were being exercised in compiling the volume, a little better perspective of view, a little more lucid and attractive form of statement, had

been added. These two defects will seriously hinder the service of the "Outlines," as they have of the "Elements." The facts which the beginner in psychology and the general reader alike need and desire, are the chief facts of modern scientific psychology in all its various departments. What is here termed "physiological psychology" is but a somewhat arbitrarily selected portion of that general body of knowledge. And within the field covered we find the same disproportion among the topics. The preliminary portion on the nervous system and the functions of the brain certainly occupies too much space for so elementary a work.

There is, too, a lack of vitality in certain portions of the work,—something that gives the student the impression that he is dealing with reports of papers and personal news, and not with facts and their interpretation. This defect is less marked in the newer work. It, too, has the advantage of benefiting by the more recent studies and the criticisms directed against the "Elements." While regretting these defects, we may none the less cordially recommend these volumes as an important and interesting means of approach to an important and interesting subject.

Animal Life and Intelligence. By C. LLOYD MORGAN, F.G.S. Boston, Ginn.

ONE of the dominant characteristics of modern English science is the attention devoted to the study of mental phenomena from a general biological point of view; the application of the comparative method, under the guidance of the principle of evolution, to the various activities contributing to and conditioning life, both bodily and mental. In so far as there exists a school of scientific psychologists in England, this is the common principle of their unity. A majority of the best known of modern English psychologists are men with a thorough and generally a professional biological training, who view the study of mind as a factor, and a most important and intricate one, in the general series of actions and re-actions of which life consists. It need hardly be said that in so doing they are continuing along the path so splendidly opened out by Darwin. It is to this school of thinkers that Mr. Morgan belongs; it is to this phase of psychology, or, if you prefer, biology, that the present work is devoted. The cardinal position of the work maintains the necessity of studying mind as a part of life, of studying it comparatively, of explaining, classifying, and studying mental phenomena by their purpose and significance in the natural, the biological world.

As the title implies, the work is divided into two portions, — the one setting forth the phenomena of animal life, the other dealing more particularly with those functions of life in which intelligence is involved; and it is extremely convenient to have so able a treatment of both topics between the same covers. For the student or the general reader whose aim it is to secure by the reading of a single book some insight into those central problems of biology, life, and intelligence, Mr. Morgan's is the book to be recommended. It is not an exhaustive treatment, but the selection of topics is according to the centres of most vital interest; and the treatment is always judicious, many-sided, interesting, and clear. After a general description of the qualities by which the organic is differentiated from the inorganic, and of the more important of the processes by which an individual life is maintained, runs the cycle of its life-history, and leaves its offspring to perpetuate the species, we are introduced to the kernel of modern biology, the relation of life to the environment. This portion of the work is considered under the heads of "Variation and Natural Selection," "Heredity and the Origin of Variations," and "Organic Evolution." While much of the contents of these chapters is mainly expository, and thus admits of originality or peculiarity mainly in the mode of treatment, the disputed points in modern biology are by no means avoided, and both sides of the case are always given. Chief among these disputed points is the one over which the biological camps are so sharply divided,— the inheritance of acquired characteristics. Mr. Morgan admirably states the importance of this issue, and returns to the problem again and again. He instructively as well as amusingly discusses the issue by considering whether "the hen produces the egg" or "the egg produces the hen." The Weismann view, which denies the inheritance of the influences of individual environment, would hold that "the egg produces the hen," and the parent egg is connected with the young egg, each developing to maturity under its own conditions; while, under the opposite view, "the hen produces the egg," that is, the egg is the offspring of the mature hen, modified since birth by a host of environmental accidents and conditions. Mr. Morgan's final position, reached by dint of much balancing and consideration, may be gathered from the following words: "Now, although I value highly Professor Weismann's luminous researches, and read with interest his ingenious speculations, I cannot but regard his doctrine of the continuity of germ-plasm as a distinctly retrograde step." So, too, in the mental world Mr. Morgan regards the hypothesis of the non-inheritance of acquired characteristics as untenable, though he fully admits the absence of crucial cases, and the possibility of interpretation of many facts from both points of view. In his final chapter he deduces from Professor Weismann's views the conclusion that education, "though it may raise the level of each generation, can have no cumulative effect;" that the diffusion of knowledge brings more grist to the mill but doesn't improve the mill, increases the store of food but not the powers of the digestive apparatus; and, in opposition to this view, it is held that the rise in the intellectual level of Englishmen of to-day, as compared with those of the days of the Tudors, has been in part due to the inheritance of individually acquired faculty."

Mr. Morgan's views on other of the factors and processes of organic evolution possess many points of interest and individuality, but it is impossible to do more than mention their existence in this connection. Some of the points which he emphasizes may be inferred from the following citation: "First, we should be careful not to use the phrase 'of advantage to the species' vaguely and indefinitely, but should in all cases endeavor clearly to indicate wherein lies the particular advantage, and how its possession enables the organism to escape elimination; next, we must remember that the advantage must be immediate and present, prospective advantage being, of course, inoperative; then we must endeavor to show that the advantage is really sufficient to decide the question of elimination or non-elimination; lastly, we must distinguish between indiscriminate and differential destruction, between mere numerical reduction by death or otherwise and selective elimination."

Entering now upon the more strictly psychological portion of the work, we meet first with a very clear and interesting account of the realm of sensation in the animal world. The keynote of the exposition is that the activity of a sense-organ must be accounted for by the utility of this mode of response to the environment in the struggle for existence. The fallacy of insisting upon an exact parallelism between human senses and those of animals is also strongly stated. The ground covered in the chapter upon "Mental Processes in Man" is familiar. It consists in the main of the description of the various processes involved in sensation, perception, inference, and the like. The two points most strongly insisted upon are that the relation to our environment involves the two factors of subject and object, of the mind that perceives and the things perceived; and that we must distinguish between the perceptual and the conceptual powers, the latter involving analysis and to some extent abstraction and consciousness. In attempting to study the resemblances and differences between human and animal intelligence, we must beware of endowing the animal with human points of view. The similarity of sense data is no guaranty for a similarity of mental perception and elaboration. In illustration of our tendency to neglect the ignorance of animals, there is cited Mr. Hamerton's story of the cow which was quieted by having the stuffed body of her dead calf to lick, and which, when accidentally tearing open the skin and seeing the hay inside, devoured the unexpected provender without showing the slightest surprise. But the surprise is only for us acquainted with anatomy: it is no incongruity to the cow, which indeed, having experience of "putting hay inside," not illogically expects to find hay there. We each construct our world, and how different the constructive powers in the two cases! In the description of instances of animal intelligence, which naturally find considerable place in the work, the analysis proceeds along a psychological basis, the degree of mental power being measured by