the superior facilities for land and fresh-water work offered by Jamaica are a far more than compensating advantage.

Finally, I should like to emphasize the very great advantage which would come to the laboratory from being located in the midst of such a hospitable community as is to be found in Jamaica. This is a point upon which Dr. Duerden would naturally not care to enlarge, as he was himself for four years a leader in extending courtesies and favors to visiting scientists. The government officials and the officials of the fruit company, which virtually controls communication with the United States, are simply unwearying in their efforts to put the visiting scientist under lasting obligations, and if Jamaica were selected as the site of the proposed laboratory, there is nothing the people there would not do to make the establishment a success, and to convince all comers that there is no place like Jamaica.

Hubert Lyman Clark.

Olivet College,
June, 1903.

SHORTER ARTICLES.

ON THE STRUCTURE OF THE PLESIOSAURIAN SKULL.

An excellent example of a plesiosaurian skull, recently kindly entrusted to me for study by the authorities of the National Museum, confirms so well the rather remarkable determinations of the frontal elements recently published by me, that I desire to make a brief mention of the matter in Science, in anticipation of a more complete description, which may be delayed a year or two. The specimen is from the Eagle Ford Shales, from the vicinity of Austin, Texas, and is, I have little or no doubt, both generically and specifically identical with the type of *Brachauchenius lucasi,* recently described by me from the Cretaceous of Kansas. The specimen lies with its dorsal surface exposed, beautifully supplementing the type specimen of the species now exhibited in the National Museum.

I have no longer any doubt that the so-called frontal bone in all plesiosaurs is in reality a rostral prolongation of the parietal bone, extending forward to meet the premaxilla, and completely excluding the frontals from union in the median line. There is no supraorbital bone, and the so-called postorbital is really the postfrontal, or postfronto-orbital. The nasal has never yet been certainly found as a distinct ossification, but the lachrymal exists as a distinct bone, though often fused with the maxilla.

The study of this specimen confirms my belief that the genus is closely related to *Pliosaurus* of Europe, from which it is distinguished by the entire absence of double-headed cervical ribs. I am, furthermore, convinced that the genus belongs to a family distinct from the true plesiosaurs, and I believe that this family is the Pliosauridæ, hitherto rejected by most students of the order. Whether all the characters given below will apply to the European forms I do not know, since the palatines are *thought* to be separated in *Pliosaurus,* and others may occur in true plesiosaurians. I would, however, define the family as follows:

Pliosauridæ: Skull depressed; no parietal crest; palatines broadly contiguous in the middle line; pterygoids with a prominent ridge and abutting mandibular process. Neck short; cervical ribs single or double headed; all vertebræ without infracentral vascular foramina.

S. W. Williston.

THE REACTIONS OF PARAMŒCIA AND OTHER PROTOZOA TO CHEMICAL AND ELECTRICAL STIMULI.

The recent work of Mathews * on the nature of the chemical stimulation of the motor nerve, and that of R. S. Lillie † on the reaction of nuclear and cytoplasmic structures to the electric current, have greatly strengthened the theory that protoplasm, at least in some of its forms, consists of a colloidal solution whose particles may be either positively or negatively charged.

The present paper is a brief preliminary account of some experiments on the reactions of *Paramœcia* and other protozoa to chemical and electrical stimuli, and the visible changes

*Mathews, Science, XV., 1902, p. 492, and XVII., 1903, p. 729.

† Lillie, *American Journal of Physiology,* VIII., 1903, p. 273.

produced in the protoplasm by these means.

The results of the experiments seem to show that in these forms, also, the colloidal particles in the protoplasm carry a definite electrical charge, and to demonstrate further that the sign of the charge depends directly on certain external conditions surrounding the organism.

The results of a series of experiments carried on last year on the effect of variations in temperature on unicellular animals suggested a very close similarity between the reaction of these organisms to variations in the temperature, and the effects of the same temperature variations on artificial colloidal solutions as observed by Hardy and others. This fact, and especially the conclusions of Dr. Mathews on the chemical stimulation of the nerve, led me to test the effects on the protoplasm of *Paramœcia,* and other protozoa of a series of solutions of acids, bases and salts, with the following results: All the acids and the solutions of all the salts with a predominant positive charge that were used in the experiments, had a common effect on the *Paramœcia,* viz., a coagulation of the protoplasm, and the formation of simple resting cells, similar to those formed by low temperatures. Likewise all bases, and the solutions of all salts with a predominant negative charge, had one and the same effect, viz., a liquefaction of the protoplasm and a stimulation of the metabolic activity of the organism, similar to the effects of a slight increase in temperature. The following solutions carrying a predominant positive charge were used: *m*/800 HCl, H_2SO_4 and HNO_3; *m*/160, *mg* Cl_2, $CaCl_2$, $BaCl_2$ and $Ca(NO_3)_2$; and the following with a predominant negative charge, *m*/800 NaOH, KOH and $Ba(OH)_2$; *m*/160 Na_2SO_4, $(NH_4)_2C_2O_4$, Na_2HPO_4 and $Na_3C_6H_5O_7$. The rapidity and extent of the coagulation or liquefaction vary directly with the valence of the salt. Thus the phosphate and citrate are effective in greater dilutions than the sulphate. The exact figures will be given in the complete paper.

The *Paramœcia* used in the above experiments were taken from cultures which were slightly alkaline in reaction. It was found that if just enough hydrochloric acid was added to the culture to give it a trace of free acid, the reaction of the *Paramœcia* to the salt solutions was nearly reversed. The protoplasm of *Paramœcia* from such an acid culture is either not affected by the solutions of salts with a predominant positive charge, or in some cases is slightly liquefied. But such an acid-modified protoplasm is coagulated in most instances by the solutions of salts with a predominant negative charge. These results agree almost exactly with Hardy's on the acid and alkaline modified colloidal solutions of egg albumen, and lead to the conclusion that in the living protoplasm of *Paramœcium,* as well as in artificial colloidal solutions, the charge which the colloidal particles carry depends directly on the reaction of the surrounding medium.

The chemotaxis of *Paramœcia* from alkaline and acid cultures was tested, and it was found that this response, also, may be reversed by changing the reaction of the culture. For example, *Paramœcia* from an alkaline culture are negative, while *Paramœcia* from an acid culture are positive to weak hydrochloric acid. It thus seems probable that the sense of the chemotropic response of *Paramœcium* depends upon the sign of the charge carried by the protoplasmic particles.

If it is true that the charge on the colloidal particles in the protoplasm of *Paramœcium* may be reversed by changing the reaction of the surrounding medium, then *Paramœcia* in an acid solution ought to show a different response to the electric current from *Paramœcia* in an alkaline solution, and experiments showed this to be the case. *Paramœcia* in an alkaline culture are strongly negative to the electric current. If, however, a few cubic centimeters of the culture containing the *Paramœcia* be isolated in a small dish, and weak hydrochloric acid added, drop by drop, a point is soon reached at which some of the *Paramœcia* begin to swim toward the anode and this reaction may be increased by a further addition of acid until half of the *Paramœcia* show a decided positive response.

Likewise *Paramœcia* which in an acid culture are positive to the electric current may be made to reverse their reaction by gradually neutralizing the acid with sodium hydrate. Lillie has observed a similar relation between the response to the electric current and the condition of the protoplasm, whether acid or alkaline, in his experiments upon nuclear and cytoplasmic structures cited above. He showed that nuclear structures, which contain a large amount of nucleic acid, move toward the anode, while cells very rich in cytoplasm, which is basic in reaction, move in an opposite direction when exposed to the electric current.

It thus appears, from the experiments on *Paramœcia* here outlined, that the conclusions suggested by the work of Mathews and of Lillie are capable of a wider application than has heretofore been given them, and that a definite relation exists between the sign of the charge carried by the protoplasmic particles and certain external conditions surrounding the organism. It also follows from the experiments that by varying these external conditions, we are able not only to reverse the charge carried by the protoplasmic particles, but also the response of *Paramœcium* to certain forms of chemical and electrical stimuli.

A. W. Greeley.

Zoological Laboratory,
Washington University, St. Louis, Mo.,
May 19, 1903.

NOTES ON ENTOMOLOGY.

Mr. W. L. Tower has given an account of the origin and development of the wings of coleoptera.* It is illustrated by seven plates and figures in text. The studies were based on species of various families (mostly phytophagous). He believes that the elytra are homologous to the fore-wings of other insects, the only logical position. As to the origin of the wings his studies lead him to accept Verson's view that the wings are derived from the rudiments of the meso- and metathoracic spiracles. Verson's theory was published in 1890, and based on his study of the silk-worm (*Bombyx mori*). Very substantial objections are advanced by Tower to the two other theories of wing-origin, that of the tracheal-gill origin and that as prolongations of the thoracic tergum. However, his evidence does not show that the ancestors of the Pterygota were terrestrial, and not aquatic.

In a recent number of the *Bericht über Land- und Forstwirthschaft im Deutsch-Ostafrika* are two articles of an entomological nature. One by V. Lommel on the tsetse-fly,* deals with the distribution of this pest in East Africa, and its habits. The other is by Dr. A. Zimmerman† and treats of African coffee insects. The most injurious species is the common coffee leaf-miner (*Cemiostoma coffeella*). An unnamed pentatomid does considerable injury to the coffee beans by puncturing them; quite possibly it gives entrance to some fungus. It seems strange to see a work published in Germany with good figures of insects but without their scientific names, which could easily have been supplied by German entomologists.

The last number of 'Fauna Arctica'‡ contains articles on the hymenoptera, hemiptera and siphunculata of the Arctic regions. The former is by Kiaer and Friese, the latter two by Breddin. There is a good bibliography, and many notes on distribution and time of flight in bees. No new species are described; but there is a fine colored plate representing sixteen species of *Bombus*.

Dr. Otto Schenk, of Jena, treats of the sense organs on the antennal surface of some lepidoptera and hymenoptera.§ He considers the sexual differences in the antennæ of these insects, the structure of the sense organs and their probable function. He arranges these sense organs in several classes, and concludes that most of them are for the detection of odors; but that the *sensilla ampullacea* or 'pits of Forel,' are probably hearing organs.

Dr. L. Melichar has recently completed his monograph of the Flatidæ of the world.‖

* *Zool. Jahrb., Abth. f. Anat.*, 17 Bd., pp. 517–572, 7 pls.

* Bd. 1, Heft 4, pp. 34–350, 1903.

† *Ibid.*, pp. 358–374, 1 pl. (colored).

‡ 'Fauna Arctica,' II., Lief. III., December, 1902.

§ *Zool. Jahrb., Abth. f. Anat.*, 17 Bd., pp. 573–616, 2 pls.

‖ 'Monographie der Acanaloniiden und Flatiden,' Ann. Naturhist. Hofmuseums, Wien, 1902.