

ART. XXVIII.—*On the occurrence of living forms in the hot waters of California*; by ARTHUR MEAD EDWARDS. (In a letter to the Editors, dated 49 Jane st., N. Y., Jan. 23, 1868.)

IN the May (1866) number of the Journal, were some notes by Prof. Brewer on the occurrence of living forms in the hot and saline waters of California, in which a slight error appeared, tending to mislead naturalists more particularly with regard to certain observations of mine. In the subsequent number for November, Prof. Brewer inserted a note making a correction in this matter, but, as the subject is one of much importance, I have taken the liberty of putting together a few notes relating thereto, and beg of you to insert them, at your convenience.

The facts in the case of the Californian water are as follows : Prof. Brewer was under the impression that I had found animal as well as vegetable organisms in several specimens collected by him during the prosecution of the State Geological Survey, and so wrote. I received but one specimen from hot or saline water, and that was gathered at the Geysers in water of a temperature of $120\frac{1}{2}^{\circ}$ F. Unfortunately the rest of the collections made at this and similar localities did not come into my hands, but I have arranged so that I shall before long have specimens of this description, and doubtless the examination of them will throw much light upon the subject under consideration. Of the material I did receive, the amount was very small, and I made, as I had been requested, a very careful examination, with these results. I found it to consist mostly of fine sand, mixed with a little of what seemed to be the refuse of decaying vegetation, which we might easily understand would be blown or otherwise carried into the Geyser. Besides these substances, I found it to contain a very few frustules of Diatomaceæ ; true aquatic plants. They are an *Orthosira*, most likely *O. crenulata* of Kützing which is the same as *Gaillonella crenulata* Ehr., and has been placed under *Orthosira orichalcea* W. S., and by Smith in his Synopsis. The number of frustules of this species is small, but enough for its determination. Besides this, I

found perhaps half a dozen frustules of a *Fragillaria*, most likely *F. capucina* Desm., which is synonymous with *F. rhabdosoma* Ehr. I also saw a fragment of a much larger species which looked as if it were *Cocconema lanceolatum* Ehr., but, as the piece was very small, I cannot be certain. There are also present some hollow hairs or spines which might have belonged to aquatic crustaceans, but are of a dark brown color, and therefore I am of opinion were derived from some insect and of extraneous origin. It will thus be seen that what I found in the single specimen I examined hardly bears out Prof. Brewer's remarks on the occurrence of living organisms in these hot waters. The only organized matters I detected were the siliceous loriceæ of Diatomaceæ, which we have no proof were living in the water of the Geyser, and might, on account of their extreme minuteness, be carried from a distance, and the hollow spines or hairs which I am convinced are of insect origin. In connection with this matter and bearing upon it in a very close manner, it will be as well to mention here, and thus place upon record, one or two facts to which it may be desirable to refer at some future time. In the number for January, 1867, vol. iii, of Max Schultze's "*Archiv für Mikroskopische Anatomie*" is a paper by Ferdinand Colm of Breslau, entitled "*Researches on the Physiology of the Phycochromaceæ Floridææ*." Therein, besides mentioning many facts of interest to students of vegetable physiology, he states that certain *Oscillariæ*, namely, the *Beggiatoa* (one of which, *B. mirabilis*, bends and twists itself in a very remarkable manner, so that it produces vermicular waves and a motion looking like the peristaltic action of the bowels) which live in waters charged with sulphates at a high temperature, and hence, during the process of their growth, decompose the salt present and cause the evolution of free sulphuretted hydrogen. In the abstract of Dr. Colm's paper in the Quarterly Journal of Microscopical Science, the writer remarks that Dr. C. says, "since this group of algæ alone can flourish in hot and strongly saline solutions, it is probable that the first organisms which were present in the primordial sea which covered the earth, and was of very high temperature, if we may reason from the deductions of geologists, were *Oscillariæ* or rather *Chroococcaceæ*." Now in the hot springs of California there have been found *Oscillariæ* probably belonging to this order, besides *Diatomaceæ*. Prof. Whitney says, (Geology of California, vol. i, page 94), "Both the earth and the stream are highly charged with sulphuretted hydrogen and sulphurous acid, and the waters hold in solution a great variety of salts, especially sulphates of iron, lime, and magnesia; these salts as well as crystallized sulphur, are de-

posited over the rocks in the cañon, giving a peculiar and vivid coloration, which is perhaps the most striking feature of the place." This is also confirmatory of the supposition of the growth of plants of this kind in these springs, and it is easy to understand how the sulphur can be eliminated from the sulphates, or even the oxygen abstracted by the vegetation, during the period of its life, and sulphids deposited. In fact, the dark colored iron sulphid is particularly mentioned by Prof. Whitney as found in abundance at the Geysers. Furthermore, in the number of the London Quarterly Journal of Microscopical Science for July, 1867, is a paper by Dr. Lander Lindsey "On the Protophyta of Iceland," wherein he mentions that in the Geysers of that country grow *Confervæ* and *Diatomaceæ*, of which latter he enumerates seven genera, and says "the abundance of Diatoms in the thermal waters of Central and Southern Europe warrants us in expecting large additions to the Icelandic Diatomaceæ from this source alone." Now it would be of extreme interest to ascertain in what way and to what degree the saline and hot waters affect species of Diatomaceæ, as collections might be made in fresh water if it occurs near the hot springs.

Besides, these forms from the saline as well as from the fresh waters of the Pacific coast should be very carefully compared with those found in the immense deposits so common in that part of the world; one of which deposits Frémont found on the Columbia river, and others have been detected by the State Geological Survey of California in that State and elsewhere. The origin of these deposits, and all facts connected with them, are of especial importance at the present time. It must, at the same time, be remembered that the fact as to what constitutes a species in the Diatomaceæ is by no means settled, as less really is known of the life history of these minute organisms than of almost any other plants. Moreover, in the study of the Diatomaceæ and allied families, the observer has presented to him extremely advantageous opportunities of making himself acquainted with many points in the phenomena of cell-life in simple as well as more complex plants and animals. I therefore ask the coöperation of every one at all interested in the prosecution of science and the acquisition of knowledge, to the furtherance of this branch of study; and to such as are able and willing to collect I will furnish plain printed directions, and to all who desire to pursue this branch of investigation I will gladly furnish all the assistance in the shape of information and specimens in my power.