moment to append a frank confession that they necessitate the admission that the explanation of amoeboid movement brought forward by him "is inadequate." Even on this point, therefore, his experiments have not furnished a tenable theory applicable to free protoplasmic forms. Add this to the author's other admission that in his oil foams "nothing was ever observed of a rotational streaming such as occurs so commonly in vegetable cells," and we are left in wonder as to what possible application his experiments can have to biological problems of any kind.

We have given so much attention to Professor Bütschli's main contention that our space does not permit of a review of his less important arguments. It must therefore suffice to say that his criticisms of the various theories of protoplasmic structure are able and interesting.

The objects of his animadversions are, however, principally those who, like Velten, Brücke and Heitzmann, have held to the necessity of an organization in protoplasm made up of more solid and more fluid parts, the more solid constituting the active reticular structure in which resides the power of contractility, the more fluid being the passive contents of the living meshwork. All that needs to be said on this point is that the theory of Heitzmann is a fair attempt to account for actually observed phenomena in natural organisms, while the speculations of Bütschli do not appear to explain satisfactorily the behavior of even his own creations.

LETTERS TO THE EDITOR.

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

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

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

Earth Worms.

THE earth worm notes and comments which have been published in recent numbers of *Science* have been of considerable interest to the writer, and this opportunity is taken to offer a few notes of observation, made at various times, bearing on the question of the cause of the appearance of large numbers of earthworms in rainy weather.

While it is not uncommon to read or hear of what are apparently well authenticated instances of "showers" of frogs, tadpoles, and fish, it is very rare to hear of any one who has seen earth-worm showers. Yet among the unobservant, the commonly received explanation of the occurrence of these animals in the large numbers that appear on our city and village sidewalks and pavements, during rain storms, is that they "rain down."

The habitat of the aquatic and amphibious animals makes it possible to accept as true the accounts of falls of such forms, because they might be taken up into the air with the water in which they live by some sudden strong uprush of air, as a tornado, but it is difficult to imagine conditions under which the burrowing earthworm could be raised to a position from which it could "rain down."

The worms which appear during rain can be satisfactorily accounted for, if a reason sufficient to bring them out of the ground can be found. Each square foot of loamy soil has, among other inhabitants, one or more earthworms living in it, so that the grass borders of streets and walks, even in large cities, harbor myriads of these animals and the soft earth in less thickly settled communities hides numbers of them beneath its surface.

Granted, then, the presence of the worms near at hand to sidewalks and pavements, cause adequate to bring them out of the earth during the rain and to make them wander about must be found. An explanation readily suggests itself, from the fact that the burrows of the animals must be full of water when it is raining, and it would seem that they would have to come to the surface or drown, and for a long time the writer was satisfied that this theory explained the appearance of the worms.

The following facts, noted at different times, tend to show that the explanation is not sufficient:

A number of years ago, while preparing some earthworms for use in a zoölogy class, I was washing them in a tank of running water, the source of supply being a small faucet tapping the village mains, the ultimate source being a small river. In the tank, which was of galvanized iron, were several crayfish, a few specimens of Onodonta and other mussels, and some snails. During the washing process, several of the earthworms slipped away into the tank, and they were left there to serve for food for the crayfish. There was no sand or earth in the tank, except a small quantity of sediment which had accumulated from the water and its inhabitants, and this was not over an eighth of an inch deep in the deepest place. Within a short time, all of the animals, except one very large specimen of a species of unio, were taken from the tank, and wishing to keep the unio alive, the water was not shut off, but left running in a small stream through the winter and the following summer. The next fall, having to use the tank for another purpose, the unio was removed and the tank cleaned. When the water was allowed to run out, in the bottom of the tank was found a large and active earthworm. The room was a private one, of which I carried the only key, and there had been no earthworms in it since the previous year, and the opening through which the water entered the tank was only sufficient to admit a slender stream of water, just sufficient to keep up circulation in the tank. The worm was carefully examined to make sure of the identity of the species, and it was permitted to escape. The sediment in the bottom of the tank was largely vegetable in its origin, and was of such character as to furnish abundant food for an earthworm, but was even at the end of the year hardly as deep as the worm was thick. The tank was about a foot deep, and the worm had lived about a year in that depth of water.

A second case came to my notice while collecting crayfish in a small river in this vicinity. The water in the part of the stream where the collecting was done was a little less than knee deep and the stream about forty feet wide. The crayfish hide under water-logged slabs and pieces of bark from the mills above, and to catch them the wood has to be moved. Under a slab in the middle of the stream was found a live and active earthworm, which was not buried in the mud, but lying immediately on the surface of it under the slab. There had been no rain for several days, and it was not probable that the worm had been washed into the stream from the bank. These instances, together with the fact that these animals are frequently abundant in soil that is saturated with water, and the observations and records of similar and more numerous cases of the same sort, noted by Darwin in his work on the "Formation of Vegetable Mould," tend to make it plain that the earthworm is not driven out of its burrow because it fears water.

From these considerations it is probable that still other causes to explain the phenomenon must be sought, but it is not my purpose to offer any theory in explanation. The following facts, however, may suggest a line of approach, along which investigation may be made by those disposed to attempt to work out the problem. If a light tapping be made on the surface of ground inhabited by earthworms, they will come to the top of their burrows, and if the tapping is kept up they will finally crawl entirely out of the ground. The birds are well aware of this fact, and robins, in particular, make use of their knowledge of

it to get many a good meal, striking their beaks against the ground, until a worm shows its head, and then siezing it and drawing it forth. It is also said that the grotesque dances which some wading birds indulge in are solely for the purpose of attracting earthworms to the surface of the ground.

My own attention was attracted to the habit by noticing that a number of worms were wriggling about my feet as I stood talking with a neighbor in his freshly plowed garden. I had been moving about and tapping the soft loam with one foot, and the worms had appeared to find out the cause of the disturbance.

The ability of these animals, in the direction of climbing, is remarkable, and probably explains their occurrence in apparently inaccessible places, such as eave-troughs, etc., although it is not impossible that they are sometimes carried to such places by birds, or even that their eggs are blown to them by the wind and afterwards hatched.

I have seen them climb out of a Mason fruit jar of the quart size, in which there was not over an inch of earth, ascending the reverse curve at the top with as much ease as they did the straight part. In this case they were assisted by a certain amount of moisture on the inside of the jar. The conclusions deducible from the foregoing are:

First, That the worms do not rain down, but come from unpaved ground, near the walks and pavements on which they are found.

Second, That in some cases, at least, they can live for a long time entirely under water.

Third, That they may be attracted to the surface by tapping or striking on the ground.

Fourth, That they climb up perpendicular surfaces easily, even those of glass, if they are moist.

CHARLES A. DAVIS.

Alma, Mich.

Cats Hunting Snakes.

IN a late number of *Science* Mr. D. S. Martin asks for information in regard to the snake hunting habit of cats. It is such a common thing for cats to hunt snakes in this region of country that it seems to be expected of every ranch cat that she, or he, will hunt them. I have often seen my cat bring in snakes from three to four feet long. These are generally what are known as gopher or chicken snakes.

In Lafcadio Hearn's wonderfully magnificent word picture of Martinique ("A Midsummer Trip to the West Indies") he describes the grand forests of tropical vegetation in words that seem to bring them before one and then adds: "The lord of all these is the terrible fer-de-lance, the trigonocephalus, the bothrops lanceolatus, the craspodecephalus, deadliest of all occidental thanatophidia." His description of this snake is fine, and the manner in which it reigns supreme over the mountains, ravines, and forests during the day and the parks, highways and places of public resort at night shows plainly that he is right when he says the king of the island is this terrible snake. But even the king has his conqueror, and though it may be a long quotation I think the readers of *Science* will thank me for giving the words of this great master of language.

"The creature who fears the monster least is the brave cat. Seeing a snake, she at once carries her kittens to a place of safety, then boldly advances to the encounter. She will walk to the very limit of the serpent's striking range, and begin to feint, teasing him, startling him, trying to draw his blow. How the emerald and topazine eyes glow then!—they are flames. A moment more, and the triangular head, hissing from the coil, flashes swift as if moved by wings. But swifter still the strong stroke of the armed paw that smites the horror aside, flinging it, mangled and gasping, in the dust. Nevertheless, pussy does not yet dare to spring; the enemy, still active, has almost instantly reformed his coil; but she is again in front of him, watching—vertical pupil against vertical pupil. Again the lashing stroke; again the beautiful countering; the living death is hurled aside, the scaled skin is deeply torn, one eye socket has ceased to flame. Once more the stroke of the serpent; once more the light, quick, cutting blow. But now the trigonocephalus is blind, is stupefied; before he can attempt to coil, pussy has leaped upon him, nailing the horrible flat head fast to the ground with her two sinewy paws. Now let him lash, writhe, twine, strive to strangle her!—in vain! he will never lift his head: an instant more and he lies still; the fine white teeth of the cat have severed the vertebræ just behind the triangular skull."

He does not say the cats eat them. Probably they do. With us they hunt, kill and eat common snakes. A writer in the Americus (Ga.) *Republican* in March, 1880, tells of a fight between a cat and a rattlesnake, but, though the cat sought the encounter, both animals were killed.

F. A. HASSLER, M.D., PH.D.

Santa Ana, Calif.

Mesabi Iron Range.

IN my paper on the "Mesabi Iron Range," published in *Science*, Feb. 9, I should have given credit to Horace V. Winchell for the rock series, instead of to Prof. N. H. Winchell.

E. P. JENNINGS.

Ironwood, Mich.

Temperature in High and Low Areas.

IN *Science* for April 14, 1893, and again for Sept. 22, I took issue with Dr. Hann, of Vienna, on a single point in his latest discussion of this question. In the *Meteorologische Zeitschrift* for December Dr. Hann again attempts to answer my argument. The original investigation was of 27 maxima and 27 minima of pressure that crossed the Alps from Oct., 1886, to Dec., 1890. In this study, the temperature and pressure at Sonnblick (10,170 ft.) were compared with the same conditions at Ischl (1530 ft.) at the base. This would give an air column of 8640 ft. Dr. Hann found that during the passage of high areas the temperature at Ischl was *higher* than in low areas, and I took the ground that this was directly contrary to the usual, well ascertained law, and hence that this whole exhaustive investigation attempting to prove that in high areas at Sonnblick the temperature is higher than in low areas must be discarded as erroneous.

Dr. Hann now makes no attempt to explain how he obtained such a peculiar result, but claims, first, that my point is a trivial one—"Die von Herrn Hazen citirten Ziffern enthalten nur die triviale Wahrheit, dass es zuweilen bei hohem Barometerstand auch im Winter wärmer sein kann, als bei niedrigem Barometerstand." Second, he shows that in the latter part of his original investigation he proved that the usual law holds in the Alps.

I desire to note one or two points in closing my share in this discussion.

First, I protest against the use of the expression "Barometerstand" in such studies. I called attention to this in 1887 in my first article on this most important theory Dr. Hann had accepted from an investigation of M. Decherows, namely, that at some height in the air the temperature was higher in a high area than in a low area. "Barometerstand" means barometer position or