higher on the west side of the break than on the east side, and duplicated by the lateral and upward thrust for nearly two feet before it droops to and passes into the smutty coal of the break.

From what is exposed, it appears that a part of the upper hill, at least down to and including the coal and fire-clay, has, from some cause, moved on the underlying strata; and at the fault the coal-bed has been broken and forced upon itself for two or three feet. The coal next the mouth not partaking of the motion of that farther in the hill, I could find no detritus of the removed part of the top coal, 10 to 18 inches of which is wanting from the opening to the fault. This would tend to prove that the faulting might have occurred in carboniferous times. The exposure of the roof-shales is not sufficient to prove the absence of such detritus. The condition of the coal at the line of fault would point to a geologically recent date of disturbance. Jefferson county is outside the region of glacial drift. SAMUEL HUSTON.

Richmond, Ohio.

The Leadville porphyry.

In the American naturalist for November, 1882, I find the following note: —

"*The so-called Leadville porphyry.* — Professor Alexis Julien read a paper at the Montreal meeting of the American association, on this subject, in which he described the result of his examination of the rock in question, in thin sections under the microscope. He finds that it is not an eruptive rock, but is sedimentary. Its material consists of the *débris* of the erosion of plutonic rocks redeposited in the Silurian ocean. He concludes that the rock is not a porphyry, but must be called a felsite tufa. The importance of this conclusion in estimating the form of any metallic ores contained in this deposit is obvious, and will be invaluable to mining experts."

Having spent the better part of two years in a detailed study of the Leadville region, an abstract of the results of which was published about a year since, I feel it my duty to correct any misapprehension which may arise from the above statement. The paper to which it refers I have not yet been able to see, and cannot, therefore, tell exactly to which of the many varieties of porphyry occurring at Leadville Professor Julien refers. I have seen slides of his in the possession of a gentleman at Leadville, which I have reason to believe were made from specimens of the rocks to which I gave the local name of 'gray porphyry,' and which had been labelled by him 'felspathic gneiss.' To whatever porphyry he may refer, however, I have no hesitation in saying, that his microscopical determinations have led him utterly astray. On what ground he decides from the simple inspection of a thin section of a rock of this character, whether it is sedimentary or eruptive, I am unable to conceive. Microscopical lithologists in Europe, and their pupils in this country, hesitate to do this without the aid of field-observation; and, as far as I know, it is only a few Americans who have obtained their knowledge of this science independently of such adventitious aid, — and who therefore, in their own opinion, know much more than those who originated the science, — that feel themselves competent to decide on the character of a rock without any knowledge of its field-habit or mode of occurrence. The mischievousness of this assumption is illustrated in the present case, where an utterly mistaken statement is given to the public by one whose name and position should be guaranties of scientific accuracy. Quite aside from any microscopical evidence, — as regards which, it is unnecessary to say, I differ essentially from the above-quoted statement, — *all the Leadville porphyries are most distinctly eruptive.* They occur largely as sheets between sedimentary beds, it is true; but they also cross these beds, occur as dikes, and carry within their mass larger or smaller portions of the enclosing sedimentary beds, as caught-up fragments.

To the writer of the above-quoted article, I would say, that, though in one sense a mining expert myself, I fail to see any possible use which Professor Julien's conclusions, had they been correct, would have been to me 'in estimating the form of any metallic ores contained in this deposit,' even had the Leadville ores been contained in porphyry, which, as a rule, they are not. S. F. EMMONS.

U. S. geological survey, Washington, D.C.

Sand-tracery.

My attention was called last fall to the curious markings, formed chiefly by the agency of plants and wind, on the beach of Lake Champlain. Seeing a notice of similar phenomena observed on the seashore by a correspondent in the second number of SCIENCE, I would add the following, which tends only to confirm some of his statements: —

In passing over the smooth beach of Burlington Bay, one is struck, first of all, by the porous condition of the sands just outlying the portions within reach of the waves. Unacquainted with this appearance, he might attribute it to some sand-boring insect, did not a closer observation teach him at once that it was effected by the spray, and due to the bursting of air-bubbles. The sand sifts over these holes until they are entirely concealed, or only a small opening is left, out of which one might not be surprised to see an insect emerge at any moment. He would also notice numerous tracings referable to the tracks of small animals. These are frequently regular and clean cut, and resemble impressions which are seen in the triassic sandstones of the Connecticut river. Again: a little observation stands one in good stead, as it shows these to be made by dry frizzled algae, rolled onward by the wind, as was remarked in the letter above referred to, or successively raised and dropped, making still more deceptive impressions. A leaf is often trundled along by a slight breeze, indenting the sand in a very regular, though seemingly fantastic manner.

Furthermore, I have frequently noticed a curious print made by the pliant stem of an alga, which had become attached at one end. The remaining portions, being at the sport of the wind, describe concentric circles at every point of contact. I thought at the time how little imagination would be required to endow such simple examples of nature's geometry with the higher characteristics of plants and animals. Would it not be worth while for some one who has the opportunity and leisure to make a comparative study of these markings, and determine how many of such trifling phenomena have been exalted higher than they deserve? F. H. HERRICK.

Burlington, Vt., March 1, 1883.

WHITNEY'S CLIMATIC CHANGES.[1]

III.

THE second part of this article discussed the relation of a general change of atmospheric temperature to glaciation. We now come to consider its relation to desiccation.

Because all precipitation depends on evaporation, and because rate of evaporation di-

[1] Concluded from No. 6.