matical sections cutting the map north and south at equal distances of twenty-seven hundred metres, showing theoretically for the whole country the subterranean distribution of the beds. In the tertiary formations an equal number of transverse sections will accompany the sheets. In the field-work, each formation will be studied monographically. One of the features of the reports will be the remarks on the subterranean hydrography. The present sheet has been prepared by the director of the survey, Mr. E. Dupont, for the carboniferous, and by Mr. Michel Mourlon for the Famennien or upper Devonian. In the accompanying text are a number of detailed sections printed on thin India paper, colored chromolithographically, and afterwards pasted in their proper place; there is also a small colored sketch-map showing the distribution of the formations in Condroz and Entre-Sambre-et-Meuse. The text is a large octavo of 66 pages.

The geological maps of Dumont have always been cited as models. By publishing the present map, the Belgian government preserves its high position as a leader in geological research. J. B. MARCOU.

LETTERS TO THE EDITOR.

Flight of the flying-fish.

IN 1871 (*Proc. Bost. soc. nat. hist.*, xiv. 137), from observation of the flying-fish in the Central-American and Hawaiian Pacific, I expressed the opinion that their flight was something more than sustaining themselves in the air by a parachute-like membrane. In the Indian ocean, in 1882, they flew from before our steamer in immense numbers; and I had ample opportunity to watch them in smooth and rough seas, and am confirmed in the statement then made, that they have the power of directing their flight. Admitting that, as a general rule, their course in the air is a continuation of their onward and upward passage through the water, and its duration as long as the expanded pectorals are moist enough to permit the rapid vibrations by which they skim along near the surface, I am sure that they can, even without touching the water with their long, lower caudal lobe, turn to the right or left, rise or fall to avoid a wave, and change direction, almost like a bird. I have often seen them sustain a flight of over a minute by my watch, and traverse several hundred yards, apparently half a mile. Their lot seems a hard one. Exposed to porpoises, dolphins, and voracious fishes, in the sea, and to marine birds in the air (happily few in these waters), what appears mere joyous amusement is really a race for life. S. KNEELAND.

Use of wire in sounding.

Since preparing the memorandum on the early use of wire in sounding (SCIENCE No. 3, p. 65), my attention has been called to two other instances of its use It appears that the wire used by Walsh was of steel, though this is not stated in the log-book. And, in addition to the ten-pound sinker, there was a registering apparatus of six pounds' weight, designed by Maury, used on at least one of the casts, according to Capt. Belknap, but not mentioned in the record.

In the same year in which Walsh made his preparations, Capt. Barnett, R.N., of H. M. S. Thunderer, on her way to the Azores from America, sounded, August, 1849, with iron wire and a sixty-one pound sinker. Only one attempt was made, and the wire broke at 2,000 fathoms. It would seem possible, that, while the Thunderer was in America, some communication might have passed between the American and British naval officers which resulted in the attempts of Walsh and Barnett.

However, a still earlier attempt to employ wire was made, which, for the present at least seems to be the earliest instance of its use. This was on the U.S. exploring expedition under Wilkes, when copper wire about three thirty-seconds of an inch in diameter, with twisted and soldered splices, appears to have been furnished to most of the vessels — at whose suggestion I have been unable to discover. The experiments were unsatisfactory, owing to constant parting of the wire; and, before the return of the expedition in 1842, the plan was abandoned. An admirable discussion of this topic, contributed by Capt. George E. Belknap, U.S.N., will be found in Hamersly's Naval encyclopaedia (Philadelphia, 1881).

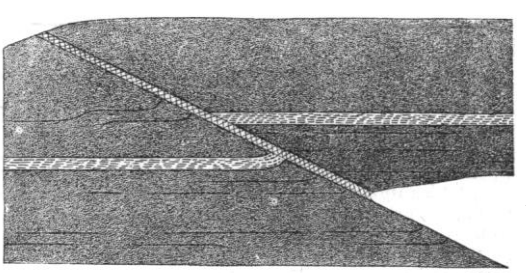
WILLIAM H. DALL.

Peculiar faulting of a coal-bed.

In a drift opening in the Pittsburg (Ohio No. 8) coal, near this place, there is exposed a rather exceptional faulting of that seam.

The fault occurs ninety yards from the mouth of the mine, where about forty feet of strata lie over the coal. The slope of the surface is quite uniform from the opening to the point of fault, whence the rise is more rapid for a short distance, when the surface becomes a level ridge, from which it falls in all directions.

In the accompanying cut of the fault, which is longitudinal in relation to the entry, the horizontal



dotted space represents the 'inbearing vein,' so persistent in the Pittsburg coal. The sloping checkered space represents the pulverized smutty coal on the line of fault, having a slope of about 30°. The bottom coal is very uniform as to thickness, except at the fault, where, from duplication and crushing in a horizontal direction, it is considerably thickened. The condition of the top coal is very different. From the fault to the mouth of the mine it varies from 12 to 20 inches, with a roof of slickensided 'soapstone,' while, immediately beyond the fault, it assumes a very uniform thickness of 30 inches.

On the east or under side of the fault, the edges of the layers of coal and slate partings are undisturbed, even immediately in contact with the crushed line. On the west side the layers and partings are all bent down where they come to the line of fault, as shown in the cut, in which the dark lines in the body of the coal represent slate-partings. Some of the layers of coal are pursed and distorted where they come to the fault. The immediate contact of the fault with the underlying fire-clay is concealed by a tramway. At all other parts of the fault, where it crosses the entry, its character is very plain. The wedge-shaped edge of the upper coal is cut off very abruptly at the line of fault, as prolonged at its normal slope up into the shale. The 'inbearing vein' is about twelve inches

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.