LETTERS TO THE EDITOR.

Cracking in ice.

I noticed recently a peculiar cracking in ice. Snow had fallen to the depth of about a foot, and had been followed by a cold rain; so that the snow was covered with a layer of ice about three-quarters of an inch thick. The snow immediately under the ice was more firmly packed than that farther down; so that pieces broken out had their under-surfaces covered to a depth of about three inches with closely-packed snow.

The cracks seemed to run over the field irregularly, without regard to the conformation of the surface. In one or two cases they seemed to have a 'radiant' point in a bunch of thistles. Their peculiarity was in the fact, that, for a great part of their extent, they were almost perfect sinusoid curves. Where a crack began, or joined another, it would run quite straight for ten or twelve feet; and then the curves would commence. Most of the curves were of the same size,—about three feet and a half from crest to crest. The two edges of the ice where the crack was were separated about a quarter of an inch to half an inch, and one was uniformly a little higher than the other.

Jacob Reighard.

La Porte, Ind., Feb. 10.

Caterpillars eaten by a kitten.

One of our beautiful springs was sadly rifled of beauty and comfort by severe inroads of insects. Elms of noble promise hung around my lawns chiefly as chandeliers for the constant descent of canker-worms. Following the gardener, a pet kitten was attracted by this novel harvest. She ate the caterpillars with infinite relish; and so long as canker-worms hung from the trees, so long did the kitten pass her time in constant leaping after the pendant worms. Among my birds, only my little Black-cap was her rival in rapid voracity. Fed by them as gathered *in bowls*, the mocking-bird was not to be named in comparison with either. M. C. Sparks.

Badly crystallized wrought iron.

This seems to be such a condition of affairs as is pointed out by Mr. Kirkaldy, who shows that a crystalline fracture is not an indication of the strength of material, but simply of the way in which rupture is effected. A sudden fracture always shows crystalline constitution. In the broken walking-beam referred to by Mr. T. M. Clark (p.169), the exterior layers doubtless yielded gradually, and the interior layers suddenly; which accounts for the crystalline appearance in the latter case, and the fibrous appearance in the former. I think similar cases will be found reported in Mr. Kirkaldy's excellent work. C. S.

Radiant heat, and the second law of thermodynamics.

The application made by Prof. J. W. Gibbs of the doctrine of radiation (Science, p. 160) would seem to me in all points to be correct, were it not really a question of the composition of velocities, of which no sufficient account seems to be taken.

To make this clear, suppose a body (such, for example, as a right cylinder) to be projected lengthwise in empty space of uniform temperature, with a velocity equal to that of radiant heat. No heat can then overtake its rear surface: hence its front will receive a double amount, and so have its temperature augmented; thus causing heat to flow along the cylinder from front to rear. But any disturbance of temperatures, such as this, is in apparent contradiction to the proposed application of the doctrine of radiations, which attempts to prove in general that no changes of temperature can arise from the motions of bodies. It is not quite certain that this would also constitute an exception to the second law, although it may well do so, because the radiations encountered may possibly cause a pressure upon the front surface; though it is difficult to see how this can be so in case it is entirely black. This illustration, then, which needs more complete discussion, will at least serve to make evident the necessity of taking into account the velocities of moving bodies in cases in which no such pressures oppose their motion. This is what has been attempted in the brief computation contained in the original paper;[1] and it seems to be admitted, in so far as direct exchanges of radiant heat between A and B are concerned, that more is transmitted in one direction along a line of apertures, *a c b*, than in the other.

Now, suppose the screens to be non-conducting, and enclosed by a non-conducting cylindrical surface; also let the entire interior of the cylinder and screens be perfectly reflecting. Then no part of the interior can be a continuous source of radiant heat. The enclosed space is also excluded from exchanges with all bodies except A and B, and these only exchange heat through apertures in the screens.

It appears possible, by suitable reflectors moving with the screens, to return to A and B respectively all heat radiated from each which does not pass through the screen *c*. Now, if a less amount of heat pass in one direction through the apertures *a c b* than in the other, then, in order that equilibrium may continue, more heat must pass through *c* along other lines. But, as there are no sources of heat in the interior, this cannot continue, although true at the start. It is therefore sufficient, in attempting to establish the proposed process as an exception to the second law, to show, as has been attempted, that more heat is transmitted directly from A to B than from B to A; since their exchanges with other bodies and parts of the apparatus may be left out of the account, as was tacitly assumed in the original paper. H. T. Eddy.

Keweenaw-point geology.

On account of certain statements in Prof. R. D. Irving's letter in Science, March 9, it seems proper to attempt to undeceive him regarding the position of some geologists towards the evidence of the Wisconsin survey, and to make clearer to others the points of discussion. That evidence has neither been ignored nor denied by them; but, while willing to grant its correctness, they deny the conclusions that Irving and his associates have drawn therefrom. Foster and Whitney, in 1850, clearly showed that the copper-bearing traps were a series of lava-flows, between which, in many places, were conglomerate and sandstone beds, composed, in part, of the *débris* of the underlying lava. These detrital deposits were laid down on one lava-flow, and then the succeeding flow was poured over all. Later, Mr. A. R. Marvine brought forward full evidence of the same kind. The present writer also collected similar proof, and, in addition, showed that the traps overflowed and indurated the eastern sandstone.

The structure of the district along a line extending obliquely from Torch Lake to Copper Falls, across the eastern trappean belt, and uniting the sandstone on both sides, is as follows: On the eastern side of Keweenaw Point a series of sandstone and conglomerate beds was laid down, having a gentle but increasing dip as the traps are approached; over these poured the first lava-flow, indurating the underlying

[1] Journ. Frankl. inst., March.

sandstone; this lava was partially denuded, and buried under a conglomerate composed of its *débris*, mingled with rhyolitic, trachytic, and granitic material. The detritus was also buried under another lava-flow; and this alternating action went on, first with increasing and then with diminishing eruptive activity, until the western sandstones and conglomerates were reached, which were laid down on the last lava-flow. It is probable the lava came from fissure eruptions. Wherever the detritus was deposited on the lava, whether within the trappean belt or on its western side, denudation has taken place, and fragments of the trap (melaphyr and diabase) have been enclosed in the overlying detritus. Unconformability would, of course, thus exist, and the writer has figured such a case; but it is the unconformability that always exists when lava flows on a shore, and is subjected to the denuding action of the waves, and proves nothing regarding the geological age.

The evidence which Irving claims has been ignored, and which he says is "proof absolute that the Keweenawan [copper-bearing rocks] series belongs below the base [Potsdam] of the paleozoic column of the Mississippi" (*Geol. Wisc.*, iii. 23), is principally the finding of a trappean rock at Taylor's Falls, against which rest sandstone and shales holding fragments of the trap and primordial fossils. Excepting the fossils, these are exactly the conditions which are found, and which ought to be found, within the copper-bearing belt, and on its western side; and it proves nothing regarding geological age, but only sequence of time. If such evidence as this is 'proof absolute' of distinct geological age, then there is proof absolute that there are as many different geological formations in the copper-bearing rocks as there are detrital beds enclosed in the traps, and proof that the last lava-flow of any active volcano, reaching the sea, is separated by a distinct age and 'immense unconformity' from the detritus deposited upon it before it is hardly cold. Unconformity of itself proves nothing, unless both formations are sedimentary; for an eruptive rock cannot, from the very nature of the case, be conformable, in the true sense, with any thing. The relations that the old basaltic lavas have, according to Irving, to the western sandstone, are exactly what they ought to have from their origin, as shown thirty-three years ago.

Again: according to the Wisconsin geologists, the Taylor's-falls trap is fifteen miles from any other so-called copper-bearing rocks, and may as well be an azoic rock; for similar ones have been collected by the writer in the granite of the Marquette azoic district. If it is referred to the copper rocks on lithological grounds, the same argument could be used to unite with this series a large part of the basaltic traps the world over. The resemblance between them is, in the writer's opinion, that which any two basaltic lava-flows or dikes have wherever they may have been extruded.

The writer has shown that the first trap on the east overflowed and indurated the eastern sandstone; and he collected specimens showing the induration, the trap, and the trappean detritus in the overlying conglomerate. Therefore Irving's statements, that the eastern sandstone unconformably overlies the trap, and that no trappean detritus occurs in the fragmental rocks, are incorrect; and the published evidence was in his hands several years ago. Irving is mistaken when he says that all the geologists who approached the question from the east felt baffled, as the writings of Foster and Whitney, Selwyn, or myself, give no indications of the kind. It may be mentioned, that in 1850 Foster and Whitney showed that a fault existed along part, at least, of the eastern side of the traps, and that the Bohemian range was a later protrusion. This evidence will explain the apparent unconformity of the traps with the eastern sandstone observed in some places.

For a fuller discussion of the copper-bearing rocks and allied formations, together with the literature down to 1880, the writer would refer to the bulletin of this museum, vol. vii. pp. 1–157.

M. E. WADSWORTH.

Museum of comp. zoöl., Cambridge, Mass., March 15, 1883.

Domestic ducks that fly abroad like pigeons.

In response to Mr. Storer's note under the above heading (SCIENCE, No. 3), I would state that in my boyhood I lived on a plantation in Liberty County, Ga., on which there were a great many domesticated ducks, both mallards and musk-ducks. Many of these latter belonged to the negroes, and were tended with but little care. Near by the negro village there was a swamp full of large trees, and often covered with water. A considerable portion of the swamp was cleared, and annually planted in rice; but many dead cypress (Taxodium) trees still remained standing. This swamp was a favorite resort for wild ducks of all kinds, especially mallards, teal, and summer ducks (wood-ducks). Many domesticated musk-ducks, especially those belonging to the negroes, flew abroad every morning, remained in the swamp (one to two miles distant) all day, and returned at night. Some of them built their nests and reared their young in the swamp, though they never became thoroughly wild.

I never observed this habit, except in the musk-duck. The reason, I think, is plain. In shape, in gait, in flight, and in habits, the musk-duck is very similar to the wood-duck (sponsa). Like the latter, it walks with freer step, it rises, flies, and alights with greater ease and grace, than other species, because the wings are broader and rounder. Like the wood-duck, also, it alights on trees. The dead cypress-trees were a favorite resting-place for the musk-ducks. Like the wood-duck, too, it builds its nest on trees or stumps, and takes down the young when hatched. I have never known the musk-duck to build on the tops of tall cypresses, like the wood-duck, but often on the tops of hollow stumps fifteen to twenty feet high.

JOSEPH LECONTE.

Berkeley, Cal., March 15.

Apparent attractions and repulsions of small floating bodies.

To obviate possible misunderstandings, it may be proper for me to make a few remarks in relation to 'E. H. H.'s' *critique* (SCIENCE, i., p. 43) on my article (*Amer. journ. sc.*, Dec., 1882) on the above phenomena.

I am to blame for whatever ambiguity attaches to the use of the term 'tension' as applied to the explanation of these phenomena. In one instance (that cited) I inadvertently used the expression 'superior *tension*' instead of 'superior *force*.' But inasmuch as in the formal announcement of the capillary principle — which is applied to the case in question, and also in the preceding as well as the succeeding context — it is very clearly indicated that the effective capillary forces (and not the *surface-tension*) are regarded as inversely proportional to the radii of curvature of the meniscuses, few physicists will, I trust, be misled by the expression.

He does not admit "that a liquid film tends to draw a solid, to which it is attached, toward the centre