by natural forces" shall depend "only upon the changes in the positions of the particles, and not upon the paths by which, or the velocities with which, they have moved from the old positions to the new."

Now let P denote the magnitude of the stress between any two particles of a system and r the distance between those particles; then Pdr is the work done by this stress during an infinitesimal displacement of the system. The work done by the stresses between all particles of the system during a finite displacement is $\Sigma \int Pdr$, in which the summation is extended to all pairs of particles and the integration covers the whole displacement of the system. Now if ΣPdr is the differential of a function of the quantities r, the value of the integral will depend only upon the initial and final relative positions of the particles. But the assumption that each P is a function of the corresponding r only (in accordance with the proposed fourth law) is only one of many possible assumptions, any one of which would make ΣPdr the differential of a function of the quantities r. The mathematical statement of the condition that ΣPdr shall be a perfect differential is given in treatises on "Differential Equations."

It thus appears that the principle of the conservation of energy does not require the truth of the proposed fourth law. The law may be true nevertheless; but it may well be questioned whether its truth is established with any such degree of probability as would entitle it to rank with the laws of Newton as a fundamental hypothesis of dynamics. L. M. HOSKINS.

Madison, Wis., Aug. 16.

The Black-Knot.

ON p. 10, Vol. XX., of *Science* appears an instructive chapter on "Black-knot," a fungous disease of the plum and cherry, of much trouble to cultivators. A point of additional scientific interest is that this fungus illustrates a principle long since presented by the writer of this, that nature does not place species where it is for the best interests of the individuals of the species, but generally has some ulterior purpose not always apparent to us who are eager to uncover her intentions. For instance, there are numberless trees and shrubs that struggle along in swamps, and are rarely found elsewhere, and these have come to be known as "swamp-lovers," but close observation has shown that the same tree or shrub will thrive immeasurably better when removed to dry ground.

On the writer's grounds is a specimen of *Clethra ulnifolia*, fifteen feet high and as much wide on an especially dry spot, and growing with a luxuriance rarely seen in the swampy spots where nature has located the plants. Some reason has been found for the appearance of these plants in swamps and not in dry ground naturally in the fact that the seeds will not sprout in dry, but only in wet ones. It looks like a *fiat* of nature. "Though you would like to grow in dry places you shall not. Something must grow for my purposes, in swamps, and you have to do it." They can only be found where the seed will sprout.

It has always seemed to the writer that it was one of the weaknesses of many discussions in the study of development, that it was generally from the individual standpoint. Nature cares only for the individual, therefore questions of nutrition, fertilization, and others are all viewed in their relation to the plant's "struggle for life." It seems rather that nature cares but little for the individual, and stands ever ready to sacrifice the whole stock when it interferes with some purpose, which we have seldom been able to fathom.

Coming to the black-knot on the plum and cherry, we have here a destructive American species *Sphæria* (*Plowrightia*) *morbosa*, of little injury in its native state, thriving amazingly when it can get as a host-plant the European domestic plum or European morello cherry. It thrives in these cases with a vigor it never shows at home. I have seen it in many parts of the east on the wild dwarf choke-cherry, *Cerasus Virginiana;* in Colorado on its close ally *Cerasus demissa;* in North Carolina sparingly on *Prunus chicasa;* and in the White Mountains on the red cherry, *Cerasus Pennsylvanica*. Recently in driving through various localities on Mt. Desert Island, it was seen on the latter much more abundantly than in any of the former cases noted; but never anywhere with the amazing destructiveness it presents in these garden representatives of foreign species. In Pennsylvania, and probably other States, the cultivated cherry has been wild for over a hundred years. It is abundant, and in some cases so numerous as to be the chief element in a piece of woodland. But though it is evidently the foster-child of the cherry and not the plum, it prefers the plum and the sour cherry. The knot is rarely found on the wild cherry trees of the sweet cherry species. For all its long hereditary cherry taste, it rushes to the plum and the morello with as much avidity as if long-continued "environment" had induced the love.

It seems to be forgotten in many discussions of the black-knot that it is an American parasite, and that it may be found in quantities everywhere that the botanists look for it. When, therefore, the State of New York tries to "stamp it out" by legislating against garden trees affected with the fungus, it seems like bailing out the ocean with a bucket. Of course, cutting down and burning destroy many spores, but the wild nests send forth myriads of young to take the places of the domesticated foes destroyed. THOMAS MEEHAN.

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Hectoring a Hawk.

EARLY one morning in August, while concealed in the grass and bushes of a White Mountain meadow, I saw an interesting encounter between a sharp-shinned hawk and a number of blue-jays and pigeon woodpeckers. Four of the woodpeckers were quietly preaning themselves in a dead pine by the lake shore, when suddenly a small and beautifully proportioned hawk dashed into their midst. They scattered shrieking, and found shelter in a fringe of woods near by. Their cries brought a kingbird to the spot, and the hawk was promptly attacked by the pugnacious fly-catcher and compelled to follow the flickers into concealment. The kingbird, satisfied with routing the hawk, hovered away over the meadow out of sight, and not long after the hawk reappeared and perched in the dead tree.

From time to time one or more of the woodpeckers came back to the tree and were at once charged by the hawk. In each instance they showed superior speed and escaped by their rapid flight. Their noise attracted the attention of a flock of about twenty blue-jays, and presently the blue-winged pirates came sailing over the meadow by twos and threes. As they neared the dead pine the hawk darted downward after their leader. The jay plunged quickly into the bushes, uttering wild cries and squawks, which were re-echoed by his companions. The hawk returned to the pine squealing pettishly, and the jays closed in upon him. They scaled the lower branches of the dead tree; they capped the neighboring maple saplings and alders; they watched for chances to brush past the hawk on his perch, and they assailed him with all the invective of their ample vocabulary. They threw themselves into the sport, as they seemed to regard it, with all the energy of boys playing "short fox."

The hawk took the matter much more in earnest; for he was hungry, and striving for a breakfast. Again and again he shot from the lofty branches of the pine, aiming first at one jay, then at another. By and by all the flickers returned, and added to the confusion by their cries and rapid excursions around the tree. The hawk in several instances seemed to lack but a single wing-beat of success, but the hour drew on without his making a capture. He grew weary. His plumage showed the chafing of the bushes. He chose lower and lower branches for his rests, and finally his sallies seemed directed more towards clearing the tree of noisy birds than to the capture of any one of them. At last he abandoned the dead pine and perched in trees having foliage. The jays followed him jeering, and he shifted his ground slowly until he gained the woods and disappeared. Then the jays crowded into the lower branches of the pine, hopped up from limb to limb until one after another gained the summit, and proved to the whole meadow that they had won the battle and fairly worried the hawk away.

The drama seemed to me to be significant in two ways; first, as