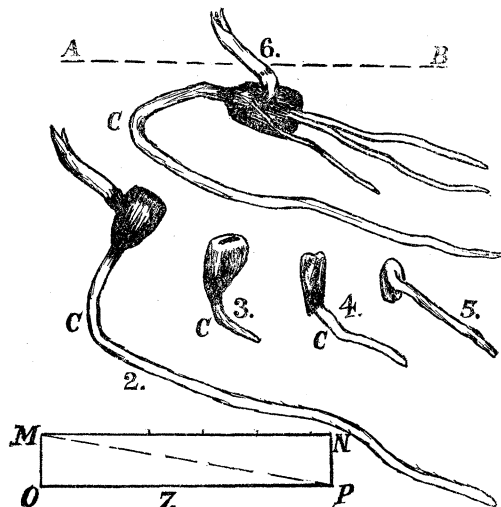


rotation commenced. The direction of the stems can be well seen in figs. 6 and 2.

The cause of this mode of growth being, of course, the outward radial tendency of the plantlet in reaction upon the centripetal force acting through the



FIGS. 2-7.

soil, we may put the intensity of the new modifier equal to the centripetal acceleration, $\left(\frac{2\pi}{T}\right)^2 r$. This gives a centrifugal 'force,' so called, of 5,348 degrees, or 5.4 *g*, at a radius of six inches. If we put *MO* (fig. 7) equal to gravity, and *MN* equal to this centrifugal 'force,' then, for an ideal case, *MP* will represent the resultant direction of the growing rootlet. This is but very loosely approximate to the observed positions, as might be expected.

CHAS. S. SLICHTER.

North-western university, Evanston, Ill.,
June 27.

Perforations in wool fibre.

In my investigations in wool fibre I have found some defective hairs that were perforated in places, evidently while growing on the sheep's back. As the perforations are perfectly circular, it would indicate that they are made by some creature at present unknown. Would it not be worth the while of some of your scientific readers to examine into the matter, and discover, if possible, what the perforator may be, and whether it is likely to remain as little injurious as at present?

JOS. M. WADE.

Boston, July 7.

The evolution of petals.

In Mr. Grant Allen's interesting treatise on the 'colors of flowers,' the first chapter deals with the evolution of petals from stamens, in which the author shows that petals are but specialized stamens set apart for the purpose of attracting insects. His proofs are such that no candid reader is likely to finish the chapter, and apply its principles to the flowers he meets in his every-day walks, without being convinced of the correctness of the author's views. The gradual devel-

opment from stamen to petal can be seen in most of those cultivated flowers which exhibit a tendency to become double, as well as in those which have already become so.

But it would seem that Mr. Allen had overlooked one point in the method of evolution. Throughout the entire book the idea is given that the process of evolution begins by the *filaments* becoming flattened. Thus, on p. 11, taking the English water-lily (*Nymphaea alba*) as a typical example, the author says, —

"In the centre of the flower we find stamens of the ordinary sort, with rounded stalks or filaments, and long, yellow anthers full of pollen at the end of each; then, as we move outward, we find the filaments growing flatter and broader, and the pollen-sacs less and less perfect; next we find a few stamens which look exactly like petals, only that they have two abortive anthers stuck awkwardly to their summits; and finally we find true petals, broad and flat, and without any trace of the anthers at all. Here, in this very ancient though largely modified flower, we have stereotyped for us, as it were, the mode in which stamens were first developed into petals, under stress of insect selection."

Again, on p. 115, he says, "It has been objected by two or three authoritative critics, that the original petals need not have been yellow, because they represent the flattened filaments, *not the anthers*;" and the author goes on to show that filaments are usually of the same color as the petals.



FLOWER OF CYDONIA VULGARIS, SHOWING TRANSFORMATION OF STAMENS TO PETALS.

An examination of a number of our common flowers shows, that, in many cases at least, the evolution of the petal begins with the *anther* rather than the filament. Thus, in the common quince (*Cydonia vulgaris*), many of the flowers possess stamens of which the anthers have become petaloid, while the filaments are of the normal type. Some of the anthers are merely flattened on one end; others are more so; while in others the anther has become a flat, white, petaloid disk on the end of a normal filament. From this, every gradation can be seen to the normal petal. In this instance, not only the pollen-walls, but the pollen itself, has become petaloid before the filament has been at all modified. In the flowers of the mock-orange (*Philadelphus coronarius*) the same transition often occurs, as well as in many of the double flowers of our gardens and conservatories.

CLARENCE M. WEED.

Agricultural college, Lansing, Mich.

Metallic circuits in cables.

When the full text of Mr. Gisborne's paper, read before the Royal society of Canada, is published, it will be shown that his anti-induction experiments with all metallic circuits in underground cables were made in connection with an electric target, for which a prize medal was awarded to him at the London exposition of 1862; and the diagrams attached to his paper will also explain why parallel metallic circuits in a *multiple* cable, unless twisted according to his design, will *not* eliminate induction of currents in

neighboring circuits. Submarine metallic circuits, both insulated and *uninsulated*, and operated upon the open-circuit system, were also experimented upon by Mr. Gisborne, in conjunction with the late Hon. F. O. J. Smith of Maine, during 1858-59, all of these experiments being upon record. D. H. K.

Too big to swallow.

Some young men standing on the shore of the Mississippi, June 27, near this place, saw something singular on the water. On going out to it with a boat, they captured it, and it proved to be a catfish with a land-tortoise in its mouth. The fish weighed a little less than twenty pounds. The turtle was about five inches across the back. It was fast within the jaws of the fish, requiring considerable force to extricate it. It was dead. The fish was in a demoralized condition, allowing itself to be captured with the hands.

P. J. FARNSWORTH.

Clinton, Io., July 3.

The gyration of a vibrating pendulum.

Referring to Mr. Hendricks's note on the gyration of a vibrating pendulum, in which reference is made to one of my statements, I wish to state that in the original paper the expression of τ by oversight was

$$\tau = \sec \theta \times \text{one day.}$$

The error was discovered soon after printing. When this was corrected in the reprint, it was not observed that it would make the sentence quoted by Mr. Hendricks state what was never intended.

W. FERREL.

HIGHER EDUCATION AND THE MASSES.

A POPULAR fallacy in respect to the worth of the higher education has rarely been so clearly put as it is by that master of fallacies, Gen. Benjamin F. Butler. In his recent response to an invitation from the National educational association to attend the convention in Madison, Wis., he says, "The higher education of the few mainly affects themselves; but *the education of the masses, which shall leaven the whole lump*, is the foundation upon which the permanency of our government must rest at last." In other words, Gen. Butler asserts that it is the dough, and not the yeast, which acts as the leaven.

Every intelligent patriot is in favor of popular education, but who are to be the teachers of the people? Gen. Butler replies, "It is the education of the masses which shall leaven the lump." The boy is to lift himself over the fence by pulling at the straps of his boots.

It is not even true in politics that the masses leaven the lump: it is the men of intellect who instruct and persuade and incite the mul-

titudes to united action. In literature and science it is quite as absurd to say that "the higher education of the few mainly affects themselves." A doctrine more fatal to the progress of knowledge, or more pernicious to the welfare of the people, could hardly be uttered by an intellectual demagogue. Did the higher education of Plato, Aristotle, Euclid, Pliny, 'mainly affect themselves'? Did the higher education of Homer, Dante, Virgil, Shakspeare, 'mainly affect themselves'? How was it with Columbus, Luther, Newton, Bacon, Faraday, — did their higher education 'mainly affect themselves'? For whose benefit all the researches of Pasteur and Koch, — 'mainly themselves'?

If Gen. Butler were alone in cherishing the fallacy that advanced education is a luxury, which pleases a few impracticable souls, and does no good to the masses, his words might pass unnoticed by *Science*; but this deceptive doctrine sways many, even, of those who are devoted to teaching. It crops out in educational conventions and in educational journals. The fallacy should be pointed out whenever it is uttered. The progress of the masses, the improvement of any age or any people, depends upon great men; great men are nurtured by great ideas; great ideas are developed by higher education, — the education which goes beyond that which is obvious to the abstract and fundamental, — the education which raises hard questions in respect to the unknown, and proceeds to seek the answer, confident that the discovery of every great truth will sooner or later contribute to the welfare of mankind.

This is an education which does not mainly affect the few and cultivated: it elevates the masses. If this truth should ever become clearly understood by our countrymen, they will do as much for higher education as they have done for popular instruction; and a happy day it will be for American civilization. Universities and schools of science will flourish as they have never done before; the government will be served by men who know, and not by men who guess; the public health, intelligence, morality, and prosperity will all be promoted.