CHAPTER II.

THE POWER OF MOTION IN PLANTS.

It would be foreign to the object of this work to say much on this interesting subject. Reference has previously been made to the motion of protoplasm in living cells, to the closing and opening of the leaves when dried or moistened, and the growth of nodes on the lower side to aid in straightening up a culm which has fallen down. The following will serve to illustrate what may not be new to all of the readers of these pages:

A thrifty hop-vine went winding up nine or ten feet to the top of a stake, and then four feet and two inches above any support, when it tipped over in the direction of the prevailing wind. It swung slowly around, sometimes making a revolution in from one to two hours. If another stick be within reach of the revolving top, it will seize the support and go on climbing as before.

Every one knows that asparagus or celery, placed on the side, will soon show the tips bending upward, and that the stems and leaves of a geranium set in the window will soon bend towards the light. These are familiar, and on that account may not awaken much curiosity, but it must seem wonderful to learn, for the first time, that the power of moving in circles or ellipses, or zigzag lines, is universal, so far as we know, to all young growing stems and all their branches. The same is true of the young leaves and all of the young roots. "Every growing part of every plant is continually circumnutating or bowing around." (Darwin). This motion is produced by the increased turgescence of the cells, together with the extensibility of their cell-walls on the convex side.

As Darwin says, "It would appear as if the changes in the cells required periods of rest. A young root may be compared with a burrowing animal, such as a mole, which wishes to penetrate perpendicularly down into the ground. By continually moving from side to side, he will find the easist place for descending. If the earth is damper on one than on the other side, he will turn thither as to better hunting ground. The root, doubtless, can only distinguish water which touches it, having no power to 'scent' moisture in the distance. It hunts like a blind worm, by feeling, rather than as a hound by scent or vision. The tip alone of the root is sensitive, and when excited causes the adjoining parts to bend. It acts like the brain of one of the lower animals; the brain being seated within the anterior end of the body. And yet the tip of the root of Indian corn, unless held in place, has not power enough to penetrate or indent the thinnest tinfoil. It does not act like a nail when hammered into a board, but more like a wedge of wood, which, whilst slowly driven into a crevice, continually expands at the same time by the absorption of water."

A young stem of corn, the plumule of the seed, bends here and there in every direction, finding the easiest place out of the soil, and after reaching the surface and growing several inches above, it swings about, making the opening at the surface of the ground slightly funnel-shaped. Some plants are sensitive to jarring or friction. Previous mention of this has been made in the chapter on leaves.

Nature not only sows and distributes the seeds of grasses, but often buries them in the soil. Seeds are generally produced in profuse abundance, enough for perpetuating the species and enough to spare for the food of small animals, and enough to provide against numerous accidents and failures. After the seeds are scattered they are often shaded by other plants which aid in keeping them moist till they germinate. Freezing and thawing, rains and melting snows cover a portion of the seeds; the wind drifts soil or leaves or other small particles over others.

In countries subject to drought, where the soil is sandy and light, the awns of *Stipa, Danthonia, Avena, Heteropogon, Anthistiria, Aira,* and some others, assist the seeds in thrusting themselves beneath the dry surface to a place of moisture, where they may germinate. Some of these literally bore their way into the soil.

When dry, the lower part of the awns of these grasses twists about, the upper portion bending off at an angle; when wet, the awn untwists and finally becomes straight. The lower part of the chaff which envelopes some grass seeds is furnished with sharp or oblique beaks, provided with stiff hairs, which act as beards. By dropping such seeds on the surface, and alternately drying and wetting them, an experimenter will find that they penetrate the sand, even in some instances extending down six inches below the surface. It seems to make no difference whether the grains are dropped among sticks or stubble, or on smooth sand, they alike penetrate the soil. Even in clay soil the seeds work themselves into the cracks where the sun has dried it; on the return of rains the cracks close, or soil covers the seeds.

If the stubble, straw or any other objects prevent the awn from turning around, the seed will revolve on its axis. Besides, if the awn is wet and held down by any object, as it tries to straighten itself it will help push the seed, like a brad-awl, into the ground. On wetting the grain and awn of *Stipa pennata,* Francis Darwin (Transactions of the Linnean Society, p. 149, 1876), found that the rate increases up to the fifth revolution, and then diminished quickly. This is shown in the table:

Turn.	Completed in		Turn.	Completed in	
	M.	S.		M.	S.
No. 1	2	30	No. 6	1	30
No. 2	2	00	No. 7	1	45
No. 3	1	45	No. 8	2	10
No. 4	1	35	No. 9	3	20
No. 5	1	25	No. 10	--	--

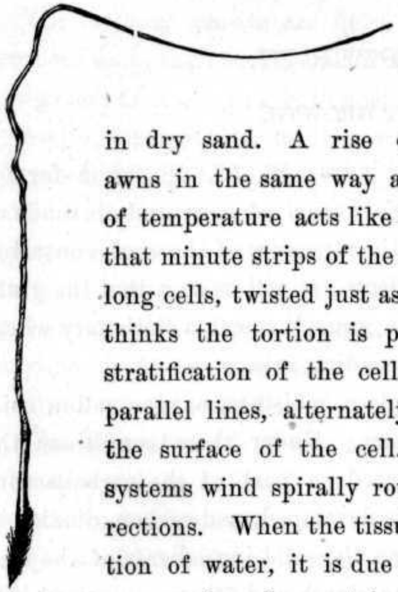

Fig. 60.—Ovary and awn of *Stipa avenacea* 1×1.-(Sudworth).

In three wettings and three dryings, a little over an inch was buried in dry sand. A rise of temperature affects the awns in the same way as increased moisture; a fall of temperature acts like dryness. Mr. Darwin found that minute strips of the awn, consisting even of two long cells, twisted just as well as the entire awn. He thinks the tortion is produced by the striation or stratification of the cell walls. These are series of parallel lines, alternately light and dark, traversing the surface of the cell. Very frequently the two systems wind spirally round the axis in opposite directions. When the tissue expands during the absorption of water, it is due mainly to the swelling of the less dense striæ. This is thought to be the cause of tortion in cotton wool. Soon after being buried, where the soil is moist, the awn breaks off at a joint from the apex of the grain. The seeds of some of these species, such as those of *Stipa spartea*, are very annoying to sheep and other animals, such as are covered with thick hair. They sometimes even cause death. [Dr. M. Stalker in Am. Nat., p. 929, 1884]. Where plenty, they penetrate clothing about the ankles of people, and produce considerable trouble. Those, like sweet vernal, which are provided with feeble awns, work their way under leaves, sticks, rubbish, and find every little hole and crack in the dried earth, when the first rain covers them with soil.

Fig. 61.—Two long cells of an awn isolated and twisting when dry. Much enlarged.—(Trans. Lin. Soc).

The fertile flowers of *Amphicarpum* are not those on top of the culms, but those out of sight and among the roots under ground.

Moles, ants, and other small animals move earth and cover seeds.