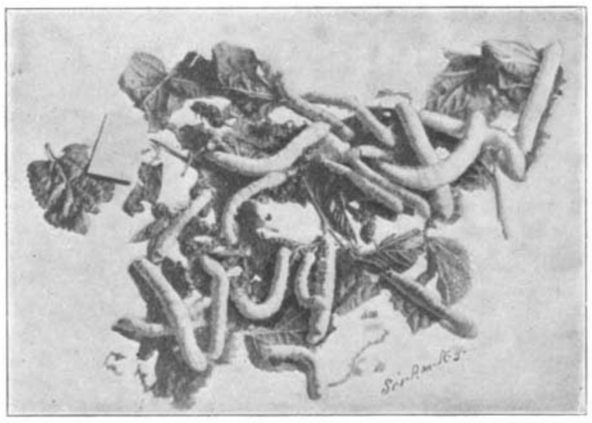
SILKWORM CULTURE IN AMERICA.

BY WALDON FAWCETT.

The movement recently inaugurated by the Department of Agriculture looking to a revival of the silkworm industry in America bids fair to prove in a considerable measure successful. That some portions of the United States are well adapted to silk culture has been conclusively demonstrated; and particularly is this true of the Southern States, where not only are climatic and other conditions favorable, but there is available some of the cheapest labor to be found any-



SILKWORMS AND MULBERRY LEAVES

where in the world—a most essential requisite for competition with the foreign silk-producing countries with their facilities for obtaining a minimum cost of production.

Silk culture ranks as one of the comparatively few activities which having once gained a foothold on this continent was allowed to languish and practically disappear. The industry was started in America in 1622 when James I. sought to foster the industry in Virginia. He sent out to the colony silkworm eggs and mulberry trees, and offered premiums for colonial silk, but after brief experiments the planters returned to the cultivation of tobacco. In Carolina and Georgia, however, the effort was more successful. Silkworms were brought by the first settlers and the industry speedily took root, flourishing for more than a quarter of a century, during all which time these two colonies exported considerable silk to London. In 1750 a silk-reeling mill was established at Savannah, and in 1759 the exports of raw silk from that port alone showed an aggregate valuation of $75,000.

The Huguenots who settled in the vicinity of Charleston, S. C., in 1677 had also taken up silk culture almost from the date of the establishment of their new home, and for nearly a century from $5,000 to

REELING SILK.

$10,000 worth of silk was annually exported from Charleston, in addition to which a considerable amount was woven and consumed at home. The Revolutionary war had a blighting effect upon the silk industry in all parts of the South, although during the conflict the raw material was made into sewing silk and sold in the home market. Henceforth, however, the history of the industry in the New World was shifted to the more northerly colonies.

The colony of Connecticut was the scene of experiments in silkworm culture as early as 1760, and within a decade after that the industry had also taken root in a small way in New York, Pennsylvania, New Jersey, Rhode Island and Massachusetts. In all these colonies the industry was seriously affected by the War for Independence, but at its close a greater effort

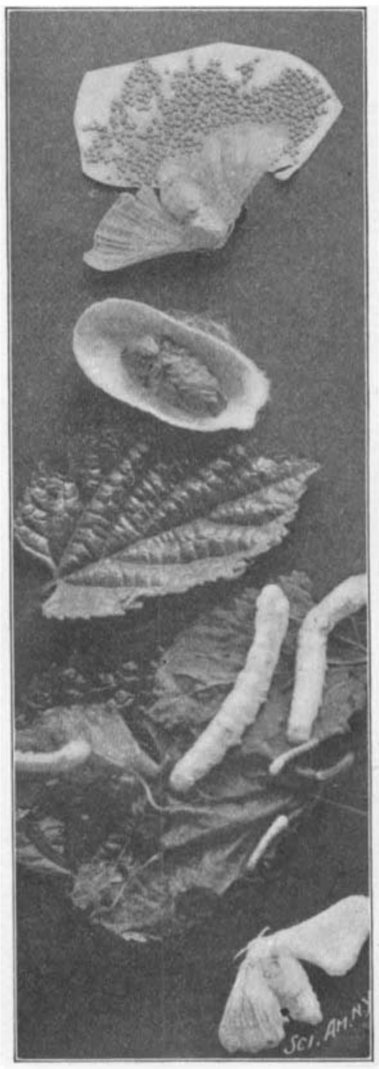
THE SILKWORM RACKS.

was made for its revival than was the case in the Southern States. Connecticut in 1783 offered a bounty to silk growers and thus attained to first rank in the amount of silk produced, a place which she held for four-score years, and in Pennsylvania Benjamin Franklin and other public-spirited citizens interested themselves in the restoration of the industry. Silk growing became popular in all the States on the Atlantic seaboard, and the Connecticut output reached a valuation of $200,000 a year, but during the years between 1838 and 1844 large nurseries of Chinese mulberry were planted, and there set in that speculative craze that in the end proved the ruination of the industry. For a time yearling trees sold for prices ranging from $3 to $4 each, but in the winter of 1844 a severe frost destroyed hundreds of thousands of the young trees. Instantly the speculation collapsed. Hundreds of silk growers who had purchased trees at fancy prices were ruined and the entire industry received a setback from which it never recovered. It was suggested that the New England silk growers plant a hardier variety of mulberry and retrieve their fortunes, but they preferred to turn their attention to silk weaving, using imported raw silk, and silkworm culture was allowed to languish.

The practical investigation of silk culture by the United States Department of Agriculture began as the result of an agitation of the subject dating from the Centennial Exposition of 1876 and was carried on by virtue of specific appropriations by Congress, continuing, practically, from 1884 to June 30, 1891. The experiments, which were conducted on an extensive scale, the work being under the supervision of the Division of Entomology, established the possibility of raising a most excellent quality of silkworm cocoons over nearly the entire country, but also disclosed the one great obstacle to the industry as a profitable enterprise, namely, the difficulty of finding labor in the United States to compete with the low-priced labor of foreign silk-raising countries in the operation of reeling or converting the cocoons into raw silk. All the later work of the Department has, therefore, been especially directed to efforts to remedy this state of affairs and to equalize by improved machinery the difference in wages between this and foreign countries, thus making it possible for the manufacturer to pay a better price for cocoons. Electric silk reels and other devices have been introduced, but even with such adjuncts there is little likelihood that the industry will be made a highly profitable one unless a heavy import duty is imposed on reeled silk imported into the United States—a rather unlikely procedure it must be admitted.

For years past silk culture has been carried on in a modest manner in various parts of the country. In Utah, for instance, there are a number of people who are raising silkworms from year to year, growing mulberry leaves for their food and actually producing silk and weaving it into cloths for family use. Mrs. Carrie Williams, of San Diego, Cal., has been engaged in the industry in a small way for some years past, and Dr. W. H. Hill has at Peoria, Ill., an institution from which over 1,000,000 silkworms are shipped annually.

As has been stated the greatest obstacle to be overcome in the establishment of the industry of silk culture in the United States is found in the labor problem, and it is for this reason that the friends of silk culture look with an especial degree of hope to the field presented by the Southern States now awakening to industrial activity. Raw silk is, it is true, the product of the cheapest labor in foreign countries, but no country has cheaper labor than is available in the Southern States. Children who are unable to do heavy field work can be employed; and, moreover, the entire task may be attended to in April and May when there is no cotton picking. What makes the plan appear especially feasible is the seemingly parallel circumstances which are found in the tea-raising industry in the South. It has been demonstrated within the past few years that tea can be grown profitably in the South, the leaves being gathered by children whose parents are delighted with the addition made by these earnings to the family income. This class of labor can, of course, be employed to pick mulberry leaves and feed silkworms. Another great advantage which will be enjoyed by the people of the Southern States in the raising of silkworms is found in the inexhaustible supply of leaves of the Osage orange which is available in that section of the country. The Osage orange leaves have been found to be as good food for silkworms as mulberry leaves and the silk produced on this diet is of the finest quality. Thus there is removed all possibility of a repetition of the losses which ruined the American silk culture industry



STAGES OF SILKWORM GROWTH.

during the first half of the last century, and finally, an abundance of Osage orange hedges obviates the necessity for any expenditure whatever in cultivation.

The silkworm is, of course, the larva of a moth. There are several species, but one variety has been under general cultivation for centuries. The silkworm

AN INSECT CAUGHT IN THE TENTACLES OF DROSERA ROTUNDIFOLIS.

eggs are nearly spherical and about the size of turnip seeds. Each female produces an average of from 300 to 400 eggs, in the neighborhood of 20,000 eggs being required to make an ounce in weight. For a time after the infant worm has gnawed its way out it consumes its own weight of leaves every day. Upon attaining full growth the insect becomes restless, stops feeding and throws out silken threads. The silk is formed in a fluid condition and issues from the body of the worm in a glutinous state—apparently in a single thread. From this silk the worm constructs its cocoon, an interval of from three to five days being required to complete its imprisonment in the fragile envelope.

In order that the silken strands may not be subjected to the danger of breakage by the moth emerging from the cocoon, the cocoons are steamed until the inclosed insects are presumably dead. After this the silk may be wound off. The outer silk known as "floss" is used for carding, while the inner cocoon is tough, strong and compact and composed of a single continuous thread. It is essential that the room in which the silkworms are reared be warm in winter and well ventilated. If only a few insects are reared all the operations are usually performed on trays set on tables, but where the industry is carried on extensively there are employed deep shelves ranged one above another. The eggs when about to hatch are spread thinly and over them is placed ordinary mosquito netting on top of which is scattered finely cut leaves. The new-born worms pass through the meshes of the net in search of food and may then be transferred to any place desired. Later little arches of twigs must be provided, into the branches of which the worms mount and spin their cocoons.

REFLEX ACTION OF PLANTS AS COMPARED WITH THE INSTINCTS OF INSECTS.

BY J. CARTER BEARD.

We have all of us been so accustomed to wonderful stories of the wisdom of ants and of bees, as well as other worthy members of entomological races, that the doubts which certain scientific investigators are beginning to entertain with regard to the truth of any assertion that attributes conscious intelligence to these little creatures, comes upon our sentimental appreciation of their ways with something like a shock.

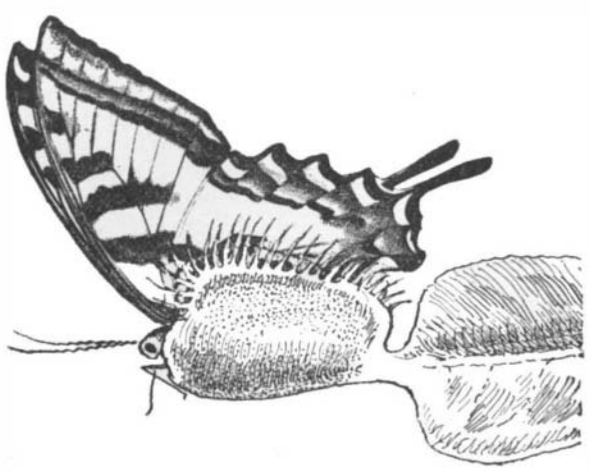
DIONŒA MUSCIPULA.

When we consider the wonderful adaptation of means to an end, the prevision and the ingenious methods employed by many sorts of insects in carrying out the purposes and objects of their lives, we are indeed inclined to credit them with intelligence of a high order. It is only after we are forced to recognize the extreme limitations of this so-called intelligence, its inflexible nature, and its inability to adapt itself to other conditions than those under which it is habitually, or ordinarily exercised, that we recognize how much is wanting in the behavior of insects to furnish conclusive evidence of their possession of any intellectual capacity whatever.

Light, for example, attracts insects in general, as it does also plants, but it does not necessarily follow that vision, in the human sense of the word, belongs either to plants or to insects.

The attraction of light governs the growth, the inclination of stems and the position of leaves; the plant reaches, so to express it, out toward the light with all the power it has—yet it does not see. The insect has eyes or organs of vision (quite different from ours), but all we absolutely know about insects is that they are influenced by light, and to aver, without more definite knowledge on the subject, that they do anything so highly psychical as seeing (as human beings see) is not only unscientific, but not at all consistent with well ascertained facts. How unintelligent is the impulse the insect shares with the plant in seeking the light, is shown by the inane manner in which moths or beetles will flutter about a white ceiling, or plunge into a flame.

Intelligence does, indeed, direct the actions of the bee in building her comb and filling it with honey, and



A BUTTERFLY CAUGHT IN THE TRAP.

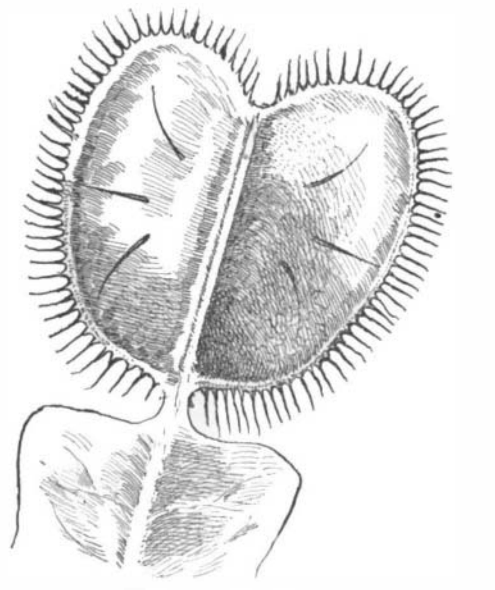
the ant in her wonderful domestic economy; but it is an intelligence quite as much above the plane of consciousness of the bee and of the ant, as it is above that of the orchid, for instance, in the admirably ingenious manner in which the flower enlists the aid of the insect in conveying pollen. Reflex actions of this kind mimic intelligence on the part of the actor, something perhaps as do the movements of the boat, said to have been invented by Tesla, which, worked by etheric waves, proceeds in any given direction, turns or dives beneath the surface of the water upon which it floats, not in obedience to any directing power on board, but at the will of a person operating a battery on the shore.

The stimuli of whatever nature, light, heat, some form of electric action, magnetism, or even more subtle, occult forces which move insects, seem to have the unvarying and unthinking nature of those supplied to mere machinery; the result is much the same as in an automaton, blind perseverance in a certain limited number of actions it is designed to perform.

Take from the cell excavated by a digger wasp, the grasshopper she has placed there, and upon which she has laid her egg, and the wasp, after entering and exploring the cell, will, instead of restocking it and laying another egg, calmly close it up, just as she would have done had it not been robbed.

Cut off the antennæ by which the wasp (*Sphex maxillosus*) drags a cricket to her burrow, and Sphex, unable to get her accustomed grip, leaves her quarry, and goes off in search of crickets which have not lost their antennæ. It does not occur to her that the creature has legs as well as antennæ.

The sand wasp (*Bembex*) can unerringly return to the entrance to her cell from the distance of a mile or more, over a featureless sandbank, and although her burrow is covered over with sand, and to human eyes entirely indistinguishable from the parts surrounding it, the wasp can alight upon the exact spot, scratch away the sand and enter the nest; but remove the surface, exposing the cell and the larvæ, and Bembex is entirely at a loss, unable to recognize either her own nest or her own offspring. Nothing can more perfectly show how an interaction of forces, without a conscious, directing intelligence, can, in a certain particular way, achieve a marvelous result,



VENUS' FLYTRAP, OPEN.

while in every other, it results in confusion and failure. The unusual happens, and an organism constituted as is the Bembex, is thrown out of gear, much as would be a machine in which a cog-wheel has failed to engage the answering cogs of another wheel.

There are in plants fully as many ingenious devices to attain some desired end, and as many adaptations to special environments, perhaps, as among insects. Plants, however, rooted as they are to one spot and in general incapable of movement, exhibit contrivance in the only way left them to do so, in their habits of growth, and in the form and arrangement of their parts, as seen, for instance, in the manner in which many provide for the distribution of their seed, and the inventive faculty, so to speak, shown in the modifications of form in orchids to secure fertilization. I say in general incapable of movement, because the rule admits of very notable exceptions.

In the telegraph plant (*Desmodium gyranus*) of India, of the three leaflets of which each of its leaves are composed, the larger terminal one erects itself during the day, and turns sharply down at night, while the other two smaller leaflets move constantly day and night, describing complete circles with a peculiar jerking motion like the second hand of a watch. Occasionally they rest for a period and then go on again, thus bringing every part of every leaf to the full action of the sunlight.

Many plants shift the position of their leaves as the direction of the light changes. This power is possessed to a considerable degree by some of our common house plants. If an oxalis shrub, for instance, is exposed for a time to the light in a window, and then turned half way around, an observer can by watching, see the leaves readjust themselves to their new position in relation to the light. Certain movements of plants seem to testify to the possession by the plants of something answering to the tactile sense in animals. A number of plants besides the common sensitive plant, exhibit apparent sensibility to external impressions and manifest also the power of transmitting the perception of these impressions from one part of the plant to another. In addition to this power, there are plants which possess a power of discrimination that certainly seems to have as just a claim to being called intelligent as are the actions of some insects.

If a drop of water, or a grain of sand, falls upon the gland-studded leaves of the sundew (*Drosera*), nothing more happens than as if they had been dropped upon the leaf of any ordinary plant; but let an insect or a bit of meat take

SUNDEW.