[For the Scientific American.]

CHRYSALIDS AND COCOONS.

BY PROFESSOR E. C. H. DAY.

While the economical importance of insects, in the injuries that so many of them inflict upon us, and the aid that others give us in keeping those that are baneful in check, renders the subject of practical entomology a most interesting one, directly or indirectly, to all classes of the community, some knowledge of the same science, from a theoretical point of view, is even of more universal and higher application. The opportunities that insects afford for the exercise of our faculties of observation, perception, and inductive reasoning, constitute them, no less than plants, important aids to elementary education. Every child should be taught systematically so much of the nature and structure of insects as should enable him, in after life, to appreciate intelligently the facts of their history, facts which are not merely interlocked with his everyday pursuits, but which will serve to occupy, advantageously, his leisure hours, broadening his mind, and increasing his recognition of the wonders of the universe, by enabling him to realize better the vast intricacy of its design, the beautiful adjustment of all its parts, and the unceasing regularity of its every action. We have striven, in the present series of papers, to impress this view upon our readers, rather than to instruct them upon the more directly practical applications of entomology; for we have a keen feeling that the ignorance that prevails of the grand truths of Nature, is at once unworthy of the intelligence of man and derogatory of the honor that is due to the Great Creator of all.

There is no portion of insect history, there is no insect so insignificant, that it may not be made to strengthen our impressions of law and order in Nature, if we will but study its structure and its habits; and perhaps no phase of insect life is more especially full of instruction than that which involves the transition from the grub to the perfect insect.

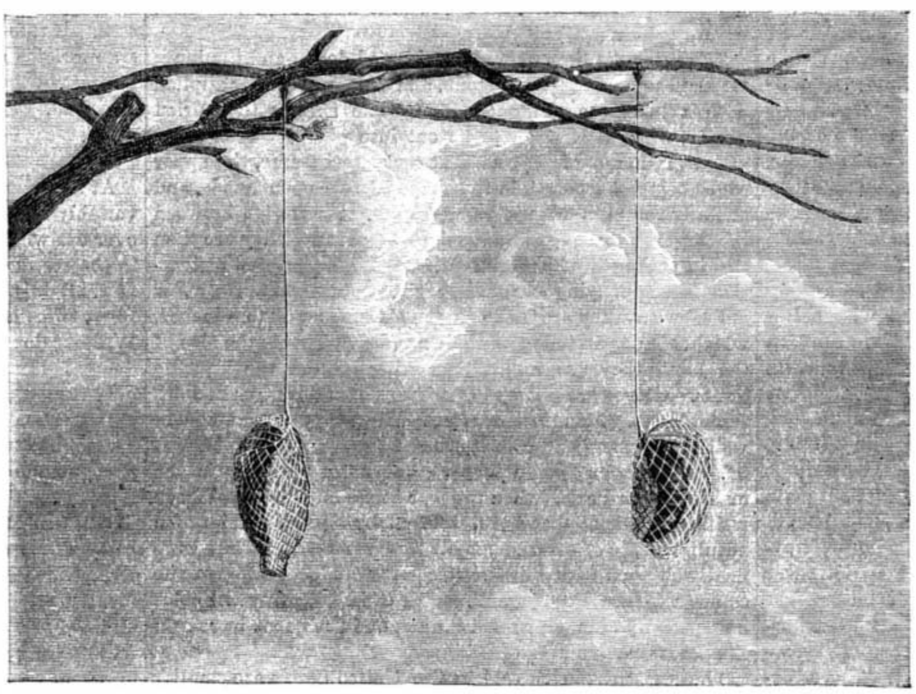
The stages of the transformation, the chrysalis, and the cocoon that contains it each and all of them are full of suggestions of wondrous instincts, of the marvelous versatility of Nature, and of the courses and methods pursued by her in even more recondite series of phenomena. Why could not, says the believer in a development theory, the same Power that established the law which evolves the chrysalis and the butterfly from the grub without any distinct creative act, by the operation of a similar law develop a series of varying forms from one primitive stock? And would it not be additional proof of the intelligence of that Power, could we show that He had done so?

The variety of ways in which the preservation of the life of the insect is secured during this, its period of conversion, from one condition of existence to another, is alone very marvelous. Take the lepidopters, for instance; and how differently do different species, often in other respects very closely allied, dispose of themselves, for security, during this time of helpless inactivity! And what a variety of instincts and of adaptations to circumstances do they not display! Let the reader, during the summer, keep a few spined caterpillars of one of our common butterflies, say of the "Camberwell Beauty" (*Vanessa Antiope*), and let him watch the process by which the limbless chrysalis frees itself from its larval habiliments; and this while fixed in the most unpromising of attitudes, that is, while suspended by a few threads at its hinder extremity. The performance is one that cannot fail to strike the observer for its ingenuity, and almost puts to shame the rope trick of those spiritualistic jugglers, the Davenport brothers. The form, too, of these butterfly chrysalids has its lesson. The peculiar angular outlines that characterize them, seem almost caricatures in their oddity; but when you find yourself looking attentively at one of these irregularly shaped objects, suspended from the weather-beaten and lichened branch of an old apple tree, and not detecting but that it is a bit of bark partly detached, and until your attention is called to the fact that it is a chrysalis, you get an inkling that its very angularity, coupled with its admirable imitative coloring, must serve as a most effective device for insuring the safety of this, the casket containing the future *Papilio*. The prying eye of the insectivorous bird will be liable to be misled as much as your own has been.

Or take, for study, some of the silk producing caterpillars. See the dense, hard cocoons that they laboriously spin, and frequently invest, in addition, with a covering of some foreign substance, as leaves or grains of earth. These seem to be a perfect protection against parasite insects that might wish to lay their eggs in such a rich supply of nourishment; but, to your surprise, you will find that the parasites have been beforehand, and had actually laid their eggs in the caterpillars prior to their commencing their defenses; and you will realize to what shifts Nature is put to keep her machinery of life exactly regulated.

Do you believe in the inflexibility of instinct in insects? Keep one of the great green caterpillars of the *Luna* moth, lately described, in a box with loose paper and, without the necessary leaves in which it might inclose its cocoon, you will find that the dull worm readily adopts the substitute, and with a spirit worthy of this age of paper collars, makes its outer jacket of the same. Think you that each instinct is an endowment created special to a kind? Surely such a strange one as that manifested by those hairy caterpillars which actually pull out their own hairs to make their cocoons, must be so! Yet see, there are others that only cut off their hairs, instead of pulling them up by the roots; and again, which rub the hairs gently off, so that after all, the first process may be but an extreme development of a much more simple instinct.

Some caterpillars seek safety by burrowing into the ground and then cementing themselves a temporary tomb; others, as certain Teneides of Brazil, whose cocoons we have here represented, suspend themselves in a delicately netted hammock in mid air. Caterpillars burrowing in trees inclose themselves in sawdust, and others living in water, undergo their changes in cases attached to the underside of the leaves of aquatic plants. The exuberance of variation that Nature thus displays in her methods is all the more extraordinary when we consider her economy of material. The same secretion which, in its simple form, cements together the sawdust or the grains of sand, in more elaborate cocoons becomes the delicate silken fiber.



COCOONS OF THE TENEIDES OF BRAZIL.

A strange, seemingly anomalous, and yet absolutely essential, character of the delicate warmth-loving insect, is its capability, if needful, of surviving intense cold. The cocoons of the *Luna*, and many other moths, lie on the ground, and must be frozen through by every frost; the chrysalids of many insects remain utterly unprotected; and we see those of the *Promethea* moth, lashed by silken cords to the twigs, swinging exposed to winter's coldest blasts; and yet at their allotted time the perfect insects are ready to sport in the extreme of summer heat.

One who can appreciate the leading principles involved in Nature, need never be at loss for mental occupation during a summer's ramble. Every plant and every insect will speak to him in simple language, but with most cogent logic, of a wisdom superior to his own; and if he will but condescend to listen to these little instructors, not a fall will come around but he will have acquired a new stock of thought to keep his mind employed during the winter months; and not a year will close, but what he will own that, in this matter at least, he is a wiser and a better man, liberalized and elevated by communion with these little beings, who have taught him in every lesson, "to look, from Nature, up to Nature's God."

A New Process for Separating Gold and Silver.

Instead of precipitating the sulphate of silver, which results from the refining of gold by sulphuric acid, by copper, it is reduced, at the works of the San Francisco Assaying and Refining Co., by protosulphate of iron. The hot, thick, turbid mass, which is obtained by treating the bullion with sulphuric acid in cast iron pots, is placed into a cast iron vessel containing sulphuric acid of 58°B. heated to about 110°C. A very small quantity of water is then added, and after a few minutes the now clear solution is drawn into a second vessel, which can be cooled from the outside. By the addition of the water all the sulphate of lead is precipitated, which carries down all impurities, and all the suspended gold. As soon as the solution in the lower vessel is cooled to from 30° to 40° C., the mother liquor is pumped back into the upper vessel, where it is again heated and treated as before with acid of 58°B. The sulphate of silver is found in hard yellow crystals in a layer one or two inches thick, containing but very little free acid. The crystals are put on the false bottom of a box lined with lead, which is provided with wheels and an opening for letting off the liquor. These crystals are mixed with a red powder, essentially sulphate of copper. A hot aqueous solution of sulphate of copper is allowed to run through them. The copper salt is dissolved first, and collected in a separate vessel to be worked for sulphate of copper. As soon as the filtrate shows the pure brown color of the sesquisulphate of iron, it runs into another vessel, where on cooling the greater part of the dissolved silver salt is decomposed, and metallic silver precipitated, which is added to the principal mass on the filter. Here the crystals have been converted into a dense coherent mass of metallic silver, which may be considered as completely reduced as soon as the iron solution, filtering through, shows a pure green color. It is washed with water, pressed, and melted. The oxidized iron solution is collected in a lead lined vessel, which contains iron scraps. It is thereby converted into a solution of protosulphate, and used again. The small quantity of silver and copper, which is precipitated by the iron scraps, is from time to time added to the crystals on the filter where the copper is rapidly dissolved. One hundred pounds of silver, reduced on the filter, require about 20 cubic feet of solution of protosulphate of iron.—*F. Gutzkon, in the American Chemist.*

How to Build Ice Houses.

W. F. H. communicates to *The Technologist* the following directions for constructing an ice house:

An ice house, he says, may be economically built in the following manner, and will give entire satisfaction, if the dimensions be not less than twelve feet square by twelve feet high for the space to contain the ice. Presuming that the ice house is only for family use, select a shady position and dig a cellar two feet deep, and let the floor or bottom be properly smoothed off with a descent of eighteen inches in the twelve feet, leading to one corner. It should be made perfectly watertight and smooth with a coating of cement; and a wall, also laid in cement, should be erected therein three feet high, formed on the top with a rabbet on the inner edge of two sides for the purpose of receiving the joists for the inner lining of the house; make the size any way you please, only not less than twelve feet square inside; erect on this wall your double frame, carefully boarded with tongue-and-groove boards on the inside, and made as tight as possible. Pack the space between the inner and outer lining with dry sawdust or tan bark up to the beginning of the roof; let the roof be steep, and also lined inside with boards, but not filled, and let a space under the peak be left open three inches to conduct the warm air to a ventilator on either side of the peak, secured by wide slats in such a position as to make ingress of rain impossible. Another ventilator must be placed in the center of the peak, the openings of which must be larger in proportion to the house (say one foot square inside), and entirely secured against rain. Let the door for filling and taking out be on the north side of the gable, arranged like the roof, not filled, and a drain pipe of three to four inches, properly cemented, run from the lowest point of the bottom of the pit at least ten feet (fifteen feet is better) under ground, with a good descent for taking off the water, and your house is ready to receive the ice, and it will keep it well for all purposes. The filling of the house should be done in this manner: Place, at the bottom of the said pit, clean corn stalks, eighteen inches deep, closely packed and leveled; then cut your ice in square blocks, as even square as practicable, and place them on the cornstalks close together, like tiles in a hall; and when six layers are completed, take a watering pot with a middling fine nose, and pour clean water gently over all crevices left, until they are closed by the freezing of said water; continue then the filling, repeating at intervals the watering process until you reach the beginning of the roof; then let the ice settle, and, if you find that the crevices have not been completely frozen, choose a very cold day to finish the watering operation. You can then put in ice enough to go half way to the peak, and you can enjoy the luxury of ice until the new crop. To make the handling of the ice easy, have a beam extending three feet from the roof outside for block and tackle, and another one inside near the peak for the same purpose; also fix an easy ladder on the inner wall on the side where the door is, and the ice can be nicely removed with the tackle and ice tongs without any trouble. When taking the ice some distance from the house, it would be advisable to use a blanket to put it in while it is being transported, which blanket should always be kept aired, and should be cleaned every time it is used. Such a building should be painted from time to time on the outside; and, whenever the ice is finished, the cornstalks should be removed and the house well ventilated, so as to be free from any unpleasant odors. If so cared for, it will last a great many years, and will require very few repairs.

PEARL MANUFACTORY.—The Chinese have, for centuries carried on a well organized system of manufacturing pearls. The invention was made early in the 13th century, and they still honor the inventor with a temple, and acts of ceremonial worship. The French pearls, which excel all others in the beauty of their imitation, are manufactured, in the first instance, out of the scales of tiny white fish, which abound in the small tributaries of the Seine and Marne. It takes from seventeen to eighteen thousand fish to make one pound of the famous *essence d'orient*. It is curious that the nearest cognate substance to the pearl is bezoar, a concretion of deep olive green color, found in the stomachs of goats, dogs, cows, and especially of camels. The bezoar used to be a valued talisman.

IF a coat of varnish be not rubbed down level, and freed from all grit and scratches, it may not be expected of the next coat that it will be perfect.