

case of a rabbit or a rat, or any such large animal, many pairs of beetles combine their labors; and when the ground beneath is soft, the interment is often completed in a surprisingly short space of time. Thus when the young grubs hatch from the eggs they not only find themselves surrounded by abundant food, but are able to consume it secure from the attacks of birds and other grub-eating creatures, to which they would be exposed upon the surface of the ground. Incidentally, it is worth noting that these insects are capital scavengers, for they hide away rotting matter in the best of all deodorizers, Mother Earth. In like manner a vast number of beetles act as scavengers, and at the same time provide food for their offspring, by burying the droppings of animals. The scarab, or sacred beetle of the Egyptians, is one of these; but hundreds of allied species, in almost every country of the globe, have similar habits. They make balls of the refuse matter, lay an egg in the center of each, and then roll the balls about in the sun to harden. Finally, a hole is bored in the ground, and the ball is buried therein. When the grubs hatch, they feed upon the manure; thus not only sustaining themselves, but mingling the valuable nitrogenous matter with the soil.

But of all insects, the most careful parents, the most accomplished nest builders, are certainly the bees and wasps. Both groups of insects are subdivided, according to their habits, into social and solitary species. The latter know nothing of joint labor, each female constructing and provisioning a few cells, or nurseries, in which to place her eggs; the former dwell together in colonies and build elaborate nests. But in all species the instinct of nest building is highly developed, while the material employed varies as much as the manner in which it is shaped into the required form.

A typical solitary nest-builder is the leaf-cutter bee, of which a number of species have been described, each using a different kind of leaf, or the petals of flowers. The species to which we will turn our attention employs the rose leaf for its architecture. The insect first searches for a rotten beam or fence, into which she tunnels, readily chipping away the soft wood with her powerful jaws. She then repairs to a rose tree, and cuts from a leaf an oblong portion. This she does as quickly as an experienced tailor cuts cloth, and with equal accuracy. The portion of leaf is then conveyed to the tunnel, one or more pauses being made by the bee for rest should the distance be great.

The insect now carries the portion of leaf to the extremity of her tunnel, treads it into place, and immediately returns for a second piece. The process is repeated until the bee is satisfied that the requisite number (usually seven) of pieces has been cut and put into place in the form of a thimble-shaped cell. This cell is then partially filled with a mixture of pollen and honey, upon the summit of which an egg is laid. Four circular pieces of rose leaf are then cut by the bee, and pressed down to form a cover for the cell; and when one cell is complete, the insect goes on to construct others until her tunnel is filled.

Each grub, when it hatches, finds itself in a snug little nursery, secure from enemies, and supplied with the exact amount of food requisite for its needs. When it has eaten what the cell contains, it will be ready to spin its cocoon and assume its pupa form, and will require no more nourishment until it emerges as a mature winged insect.

This is merely a typical example of a solitary Hymenopteron. Innumerable other species abound in summer, and each has its own way of providing nurseries for its progeny. Some small kinds of solitary wasps build with mud in holes, and if they can find a hole ready made, they willingly make use of it. In most museums we may see specimens of such nests fitted into the hole in a reel of cotton, a pipe stem, or some such homely article. But if the reader will take the trouble to examine discarded domestic objects of this kind which have been lying long in an out-house, or upon a garden heap, he is quite likely to find these wasps' nests for himself, and may have the satisfaction of hatching out the wasps in due season.

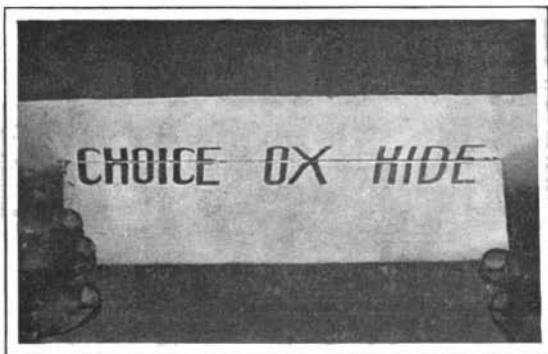
It is, however, among the social wasps that we find the most wonderful builders; we find, too, a most remarkable physiological difference between the insects themselves. Solitary wasps and bees are merely divided into two sexes—males and females; but among social species we find not only males and females, but also a large percentage of imperfect females, known as workers. These workers, although they are capable of laying eggs, and do at times lay them, are said invariably to produce males, or drones. They of course bear no direct part in the perpetuation of the species, but they constitute a powerful labor factor in the insect community of which they are members, and it is owing to their ceaseless labors that the marvelous nests, consisting of thousands of cells, are built up and repaired.

Much has been written respecting the habits of social bees, so that we may devote our remaining

space to a brief consideration of social wasps as typical of communal nest builders in general. Unlike bees, many kinds of which pass the winter in their nests, sustaining life upon the provisions which they have collected during the summer, wasps succumb before the increasing cold of autumn. But from this merciless scourge of mortality a few wasps escape. These are the "queens" of the next season. They pass the winter in some warm cranny, and when the spring arrives, each one comes forth from its hiding place, and seeks a suitable position for the nest that is to be. This found, the queen repairs to a fence or tree trunk, and with her jaws rasps off a bundle of wood fiber which, when moistened with saliva and kneaded, forms the paper-like substance of which the nest is entirely constructed. For just as bees have, so to speak, invented a special nest-building material which we call wax, so wasps have acquired the habit

"ՆԻՍՈՐԸ ՆԱ ԴՈՄԸ"

The Mysterious Script.



Its English Translation.



A Case of Temporary Illiteracy.



An Extraordinary Inversion.

SOME EXPERIMENTS WITH A MIRROR.

of preparing for the same purpose a rough, but very durable paper.

The queen-mother lays the foundation of the city with her own hands—or, rather, with her own jaws. She attaches a sort of stalk of wood paper to a chosen support. This may be the branch of a tree, a root in a cavity below the ground, or a beam in a garden shed. The choice of locality varies with the species of wasp. But the stalk prepared, the queen proceeds to construct a few shallow cells, in each of which she lays an egg. After this she continues to form more cells, and to lay more eggs; and ere long she has to feed the young grubs which have hatched from the first batch laid, so that her time is fully occupied. Soon, however, some of the grubs turn to pupæ, and the pupæ to perfect wasps—worker wasps, which take over the labor of the young colony. Thus, the city grows rapidly, until the vast nest, with its thousands of cells, comes into being.

In conclusion, special attention may be called to the durability of the wood-paper manufactured by the wasps. Even in the case of the frail nests built in

the open by tree wasps, the power to withstand the effect of rain is very great; while the nests of the tropical species seem designed to resist the heaviest downpours. Such a nest is shown in the accompanying photograph. It was cut from an orange tree in Brazil, and its smooth exterior resembles thick cardboard.

SOME EXPERIMENTS WITH A MIRROR.

BY GUSTAV MICHAUD, COSTA RICA STATE COLLEGE.

Ask your friend whether he can decipher the following sign, which you pretend to have read over the shop of an Armenian shoemaker.

He will probably tell you that he is not conversant with Oriental languages. Tell him that the sign is written in good English and, while he smiles incredulously, lay a frameless mirror perpendicularly on the mysterious script, right across the quotation marks. The result is shown.

We understand at once that the reflected image is the faithful copy of the written half, and we consequently believe that if we were allowed to see in a mirror our pencil, our hand, and the paper on which we write we would have no more trouble in writing and reading what we have written than if we were directly watching our pencil at work. This is too bold an inference, and the following experiment shows how far it is from being true:

Ask your friend to write anything he chooses, with the condition that he shall see his hand and read the script in the mirror only. With the help of a few books arrange the mirror and the paper as shown herewith.

The writer sets at work, but will not probably go farther than the first letter. His hand seems to be struck with *paralysis agitans*, and unable to write anything but zigzags.

You take his pencil and write rapidly and correctly in the same conditions. Your secret can be told in a few words: First, close your eyes; as long as you strive to follow the pencil in the mirror, your efforts to write are vain. Second, write in printed capitals and make no attempt to write anything but the pseudo Armenian sign and a few other sentences which participate of the same characteristic. What is that characteristic? It is not hard to find. Find it.

The peculiar inversion of objects viewed in a mirror is of course the cause of the difficulty felt in reading or writing. The writer is left free to write from left to right, but finds that while he is so doing, the mirror upsets his letters. There is an entirely distinct kind of inversion which can be best observed with the help of a mirror. The most suitable time for the making of the following experiment is after a meal the menu of which included soft-boiled eggs. Take an egg shell and trim it with scissors so as to reduce it to a half shell. In the hollow bottom, roughly draw with your pencil a cross with pointed ends. Bore a hole, about the size of a pea, in the center of the cross. Place yourself so as to face a window, the light falling upon your face, not upon the mirror which you hold in one hand. Close one eye. Place the shell between the other eye and the mirror, at a distance of two or three inches from either, the concavity facing the mirror. Through the hole in the shell look at the mirror as if this were some distant object. While you are so doing, the concave shell will suddenly assume a strongly convex appearance. You may then examine it directly in all its parts; no amount of auto-suggestion will allow you to get rid of the illusion. To destroy it, it becomes necessary either to open both eyes or to withdraw the shell away from the mirror. The nearer the shell to the mirror and the farther the eye from the shell the more readily comes the illusion.

The hole in the shell acts as a diaphragm, and its position, at some distance from the eye, favors the localization of the luminous pencils in the crystalline lens. Those which are emitted by the marginal parts of the egg are refracted exclusively by the marginal parts of the crystalline lens. They are more bent and give smaller images than the pencils which are sent by the center of the shell. The decreasing scale of reproduction from the center of the shell to its periphery offsets the influence of distance on the appearance of images of points situated on the anterior or posterior parts of the shell.

In a recent issue of the Railroad Gazette Mr. A. Stucki presented some very interesting data on the relative costs of steam and gas power, basing his estimates on conditions obtaining in Pittsburg, and assuming a plant of 1,000 horse-power. He stated that the cost of 1,000 horse-power per year would be \$13,125, a high-speed non-condensing engine being used, and \$8,625 in the case of a triple-expansion condensing engine. The cost of the coal used was taken at \$2.50 per ton. With natural gas at 15 cents per 1,000 cubic feet, 1,000 horse-power per year would cost \$4,500, while if producer gas made from Pittsburg coal were used, the cost of the same amount of power would be \$3,675.