WASPS *and* *their* WAYS

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WASPS AND THEIR WAYS

W A S P S AND THEIR WAYS

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"THE HONEYMAKERS," "BEE PEOPLE," ETC.

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INTRODUCTION

THE wasps, bees, and ants, as well as the gall-flies, saw-flies, and a few other insects, are branches of the same family tree, being doubtless all descended from some common ancestral stock that flourished in long-ago geological ages.

They are classed by man in what he calls the Order Hymenoptera, or Order of Membrane-winged Insects, — a very misleading name, as other insects are quite as membrane-winged as these.

The Hymenoptera resemble the general family of insects in possessing a distinct head, thorax, and abdomen, each of these parts having functions of its own.

They differ from other insects in the manner in which abdomen and thorax are united; also in the details of the mouth parts, in the wings, and in other parts of the body.

In the youth of their race the efforts of the hymenopterous insects were directed toward the accomplishment of certain acts that others of the insect folk did not care to perform.

The consequence of desires that progressed as they were gratified, aided by environment, was the gradual development of the general characteristics of the hymenopteran Order.

Again, in the early ancestral history of this Order, each division of it worked in a certain direction, pushed along by a combination of internal and external forces that finally resulted in the well-defined divisions of Bees, Ants, Wasps, etc., with characteristics more or less fixed. The wasps acquired the wasp form and the wasp nature. Their habits were wasp habits. The bees forsook uncertain lines of conduct and settled into indisputable beedom. The ants drew lines fast and firm about

their family form and habits, and thus separated themselves from all other hymenoptera.

Early in their history there was no distinction between bees and wasps. There were no bees, no wasps. There were insects wavering, as it were, between becoming bees or becoming wasps, and some of these, caring only for honey and pollen, in time crystallised into bees with the necessary structure and mind for procuring a living of pollen and honey. Others, more adventurous and more carnivorous in their appetites, crystallised finally into wasps, with their strength, ferocity, and skill in capturing living prey.

It must not be supposed that the tendency toward beehood resulted in the development of but one form of bee. Though all the beeward-tending insects preferred pollen and honey, not all of them devised the same way of getting and using their pabulum. There developed one

class of bees where the females made holes in the ground, and buried in each a ball of pollen, in which one egg was laid.

In another class the female buried a mass of pollen in the ground, in which many eggs were laid. The young from these ate holes in the pollen mass and at length formed about themselves cocoons, which when vacated were stored with honey by the bees that did not abandon the nest, but continued to live in colonies or families. This is still the method of our bumble-bee whose race-childhood was not so clever, and who did not get so far along the road of progress as the hive bee. Some of the bumble-bees added wax to strengthen the covering to their nests and even to build more cells. But they still made primitive cup-shaped cells and it was left to the honey-bees to perfect the idea and construct waxen combs of hexagonal cells to contain their young and their food.

The bumble-bee, in producing a colony of workers to advance the interests of the family and help to rear a numerous progeny, took a long step ahead of the solitary little pollen-collector that makes a hole for each larva.

But the bumble-bees die in the fall, — all but the perfect females, that live to start each one a separate nest next season.

The hive bees took a long step in advance of the bumble-bees when they created a lasting colony, one which stored up provisions and survived the winter, ready to fly forth at the first sign of spring to continue the work of the hive, instead of having each year to start it from the foundation.

The story of the bees is the story of the wasps. One class has stopped at the less intelligent stage of solitary existence, where the female digs a hole in the ground or otherwise constructs a nest, provisions it, and lays her egg.

Another class has taken the important step of living in colonies, its colony in one respect resembling that of the bumble-bee rather than the highly organised community of the hive bee. For the colony disappears at the close of the summer, only the perfect females surviving to begin the circle again next season.

The social wasps build combs of hexagonal cells, like those of the bees. But instead of secreting wax for it, they manufacture paper of wood-fibre; and instead of standing the comb on its edge, most of them suspend it mouth down.

How came bee and wasp to build a similar comb of such different materials? And why does the wasp hang its comb mouth down where the bee stands its on edge?

Did all comb-makers originally hang their cells mouth down? And did the idea of storing honey cause the bee to

change the position to prevent the honey from running out?

To this day the queen-bee cells hang mouth down, and they are the only cells in the hive that never contain honey!

Did the bee and the wasp get the idea of cell-making from some common comb-building ancestor who had not yet differentiated into a true bee or a true wasp; an ancestor wavering between paper and wax, some of whose descendants chose one and some the other; an ancestor wavering between pollen and insect food?

Or did the comb-building habit arise after bees were bees and wasps wasps, — a like necessity resulting in a like construction?

One would like to turn back the pages of time for a glance at the primitive history of these remarkable creatures, but the book is closed and locked, only the page of to-day being available to those who can read it.

From this page we learn that bees and wasps differ but very slightly from each other.

Indeed a novice might find it hard to decide between certain insects, as to whether they were bees or wasps, were it not that bees being pollen-gatherers, have provided themselves with implements for pollen-gathering; they are peculiarly hairy, while wasps, to whom collecting hairs would be a waste of protoplasm, have not clothed themselves with a pollen-collecting coat.

They have no hair-baskets on their legs and no brushes on legs or body for collecting pollen.

They are longer and more slender than bees, as a rule, and generally they wear a livery unlike that of the bees. Some of them have tongues for honey-gathering vying in length with the serviceable organ of the bee, and some of them, in tropical

countries, build combs that are not suspended mouth down but are built in concentric spheres, the position of most of the cells being more like that of the honey-comb than like the ordinary wasp-comb. Some of them store food in their cells, and with some this food is a true honey.

Bees are probably the latest evolution in the insect world.

The Order Hymenoptera, on the whole the most advanced of all Orders, is a late development according to the geological records, and in this Order the wasps precede the bees in time, the marvellous honey-makers being the last and the highest product of hymenopteran evolution.

The wasps, in consequence of slight differences in their structure, have been artificially separated into two families, the true wasps and the digger wasps.

The true wasps can readily be distin-

guished by their wings, which are folded fan-like down the middle.

The digger-wasps are all solitary, while some of the true wasps are solitary, and the rest, belonging to the family Vespidae, are social.

The Vespidae live in communities and build a common habitation. There are three genera of them in the United States, one belonging to California, and the other two, *Vespa* and *Polistes*, to the country in general.

To the genus *Vespa* belong the hornets and yellow-jackets. These build nests of paper, enclosed by thick paper walls. The hornets of this country generally suspend theirs from a tree-branch or the roof of a building, while many of the yellow-jackets prefer a hole in the ground, though some species build, like the hornets, in the open air.

Polistes builds also a paper nest, but she does not enclose her combs by outer walls, as does *Vespa*.

There are a great many species of solitary wasps in the United States, and they are very difficult to classify. They do not build nests of paper, but bore holes in the earth or in wood, or make nests in hollow stems, or build them of mud against the walls of buildings or under stones or on bushes.

Wasps possess a more versatile, if lower, intelligence than bees. Bees have become crystallised, as it were; their habits are formed; they have arrived at perfection along their line, and therefore are in a condition of suspended development.

Not so wasps, — they have not arrived; they are arriving. So, while bees stand highest structurally and socially, their communities organised and in working order from wax-secreting to honey-making, wasps are yet blazing a way through the unknown wilderness of wasp possibilities. They yet have their problems to solve and are yet to a far greater extent

than bees dependent upon their wits to see them safely through their little span of life.

Although the solitary wasps are so numerous in species, the social wasps are those best known to literature.

Like the bees, their strength lies in numbers.

They make elaborate and wonderfully ingenious habitations for themselves, and rear their progeny under the influence of the home. They can thus accomplish results impossible to creatures of solitary habits.

The social wasps have always been objects of interest, because objects of fear, to man.

One wasp may be ignored; not so a thousand wasps.

They command attention and even prompt and energetic action when circumstances bring men in contact with them.

I. VESPINA OR TRUE WASPS.

Solitary { Masaridæ
              { Eumenidæ

Social-Vespidæ { Vespa
                      { Polistes
                      { Polybia (California)

II. SPHECINA, FOSSORES, OR DIGGER-WASPS.

All solitary (many genera).

PART I
THE SOCIAL WASPS
OR
VESPIDÆ

Wasps and Their Ways

VESPA, THE PAPER-MAKER.

“**V**ESPA, the wasp, is an angrie creature,” says an old writer.

“Vespa, the wasp, is an angry creature,” says every writer, old or new, who has said anything about it.

One would think she did nothing from morning till night but sting.

Listen to the Ettrick Shepherd, —

“O’ a’ God’s creatures, the wasp is the only ane that’s eternally out o’ temper; there’s nae sic thing as pleasin’ him.”

Then he describes a pleasant scene in the garden with the birds and bees in the sunshine, and again bursts out, —

“Amid the general dance and minstrelsy, in comes a shower o’ infuriate wasps, red hot, as if let out of a fiery furnace, picking quarrels wi’ their ain shadows; then roun’ and roun’ the hair o’ your head, bizzing against the

drum o' your ear, dashing against the face o' you, who are wishin' ill to nae leevin' thing; and although you are engaged out to dinner, stickin' a lang, poishoned stang in just beloe your ee, that afore you can run hame frae the garden swells up to a fearsome hicht, making you on that side look like a blackamoor, and on the opposite white as death; sae intolerable is the agony from the tail of the yellow imp that, according to his bulk, is stronger far than the dragon o' the desert."

That is a spirited tribute to the temper of my lady the wasp, but she does not deserve it. *Vespa* is not angry excepting when an honest wasp ought to be.

She will not endure having her nest torn down about her ears and her dear grubs and her eggs killed before her eyes.

She falls into a fine rage when boys or other folk or animals whom she fears come close to her paper palace or stumble

into her underground apartments with big, clumsy, all-destroying feet.

Upon such occasions she is not merely angry, she is boiling mad, and pounces upon the offender regardless of his size, shape, or position in society.

She is ready to fight against any odds, and never runs away.

When people behave thus we call them brave.

Wasps sting when they have to, or when they think they have to, and perhaps they are rather quick to decide that an intruder means mischief to them and theirs; but they are busy creatures, and when disturbed cannot waste time instituting a court of inquiry.

They know the saving value of a pointed remark promptly made, that nobody can misunderstand or stop to argue about.

Whoever loves wasps need not fear them; whoever does not had better keep away.

They know when they are understood, and yield readily to the superior mind of man when it takes the trouble to understand and control them.

Pastor Müller in 1811 so mastered his wasps that he could handle their nest. He even cut it open as fast as they built it up, so that he might keep the inside part exposed to view and watch all the operations. Sometimes he carried the nest away; then, when the wasps that were out gathering food or nest-making materials came home, they sat in the empty hive where he usually kept their mutilated but still loved habitation, and waited patiently for him to bring it back.

— The hornet is the largest and most powerful of the social wasps, and the fame of her sting has gone abroad in all the lands of the earth.

The hornet of this country may be known by her white face and by the white markings on her body.

She is called *Vespa Maculata*, but in some parts of the Eastern States the big brown and yellow *Vespa Crabro*, or European hornet, that likes to build in hollow trees, has found settlement.

The yellow-jackets, as everybody knows, are black, marked with bright yellow.

They too are famed for their stings; for, though they are smaller and weaker than the hornets, they possess courage and determination equal to their larger relatives, and the occupants of a well-stocked yellow-jacket's nest under provocation can put a man or a horse to flight almost as quickly as can a nestful of angry hornets.

There are several species of yellow-jackets, some scarcely larger than flies, some almost as large as hornets. They all resemble each other in general appearance, however, and their habits are essentially the same as those of the hornets.

Indeed the yellow-jackets and hornets are so much alike that it is necessary to make the acquaintance of but one to know both.

HAVING EYES, THEY SEE.

ALTHOUGH the Vespæ have formed violent attachments to most of us at one time or another, so that we may consider ourselves fairly well acquainted with them, our attention has been mainly directed to their sting end and to their general personal appearance.

We know Vespa, but few of us have given much thought to her eyes, though those bright orbs were no doubt responsible for the success with which she attached herself without invitation to our persons.

Besides the two compound eyes with which we are all familiar she has a group of three simple ones, which she, like the cyclops, wears in the middle of her forehead, but which by no means afford her

cyclopean vision. Indeed, many writers deny to them any serviceable function whatever. They allow them a certain sensitiveness to light, but that is all.

If it is true, as seems probable, that these three little eyes, or ocelli, are an heirloom from Vespa's distant but very important ancestor the worm, then we can permit her to wear them merely as ornaments, or as glistening reminders of the time when she was a plastic worm with the glorious possibility of becoming a winged and a stinged creature.

But while one so readily accepts the judgment of the scientists on the ocelli, it is another matter when they declare the compound eyes also to be very inferior visual organs, able at the best to give but an impression of light, of color, and of moving objects. The compound eyes of insects are a later development than the ocelli; they are complex in structure and are always present, excepting where the

habits of the insect make eyesight unnecessary. They are composed of many simple eyes or facets grouped solidly together. Since these complex eyes have been developed at much cost, it is not unreasonable to conclude they are for purposes of seeing; nor may it be wholly rash to suggest that they may be even better organs of vision than those possessed by man, — a conclusion our vanity might make it hard for us to accept.

Certainly insects act as if they saw, and saw well, as when young bees, leaving the hive for the first time, fly close to it facing it, and do not go away until they have apparently located its position and learned to recognise it at sight.

Wasps, too, when leaving prey to which they wish to return, act as if they were locating the place, as they fly about carefully examining the neighbourhood before leaving, and when they wish to return are able to find the exact spot, unless mean-

time some conspicuous landmark has been changed, as by the removal of a large leaf, or a twig, or by the trampling down or cutting away of the grass, when they are as confused as human beings would be under the same circumstances, and sometimes are unable to find the place at all.

Predatory insects, again, have very large eyes, and are able to distinguish the particular insect they want, even at long range.

And any one who has hunted the large fossorial wasps among the goldenrod cannot doubt that these wary insects see the approach of their would-be captor.

A tame yellow-jacket kept under a tumbler immediately turned its head and pointed its antennæ at the approach of its keeper. Its gesture irresistibly suggested that it had seen the person coming; and the performances of the digger-wasps

when one is sitting near their holes would lead to the conclusion that they can see, and see well, if eyes are eyes in insectdom, and if gestures mean there what they do with us.

Each of Vespa's compound eyes contains several hundred hexagonal facets, and they doubtless enable her to see long distances, as she is exceedingly swift, strong, and direct in her flight. Unlike the honey bees, she has no hairs between the facets of her eyes.

A white or yellow semilunar line cuts her compound eyes partly in two above the antennæ. Her forehead seems to infringe upon her eye-space indeed, and by thus cutting into her eyes gives her ladyship a very decorative front.

The faces of wasps vary greatly in appearance, the shield-like "clypeus" above the jaws being coloured and shaped differ-

ently in different species, so that by their faces they are known, one method of classification being founded on the facial markings. Wasps quickly distinguish colours. This has been proved by putting papers of different colours over the entrance holes to the nests of the ground wasps and watching what happened. Red paper, with a hole for the wasps to go through, was put over a nest and occasioned great excitement, but in the course of about three hours the wasps became accustomed to their decorative doorway and went in and out through it as though that had always been their habit.

When the red paper was exchanged for blue the wasps were as excited as before, though they more quickly became accustomed to it.

When the wasps had become used to going in and out through the blue paper a number of them were caught, the blue paper was removed, and the wasps

were liberated. Missing their blue landmark they buzzed confusedly about, not knowing how to find the nest, until the blue paper was replaced, when they all went in.

Once, red paper having been left over the nest for twenty-four hours and then moved a foot and a half away, many wasps went through the hole in the paper as usual, doubtless expecting to find the nest entrance underneath it.

The coloured papers were frequently changed, and the wasps finally learned to look for these changes, so that fewer and fewer were deceived.

Which proves that wasps are capable of being educated, and suggests a new field of experiment.

A nest of trained hornets might not be attractive to everybody, but it would be interesting.

The wasps, having learned to expect different coloured paper porticos, were

finally deceived by having the paper removed entirely!

Not a wasp recognised its hole until the paper was replaced, when they went tumbling in six or seven at a time.

WITHOUT EARS, THEY HEAR ;

WITHOUT NOSES, THEY SMELL ; AND WITHOUT
TONGUES, THEY CONVERSE.

ALL of which is possible because they possess antennæ, the most remarkable organs of special sense, all things considered, in the world.

These sensitive feelers have their origin between Vespa's eyes, and are necessary to her existence as well as to her personal appearance.

She would look as unfinished without them as a man would without his ears or nose ; and may it not be that in hornet-land the handsomest hornets and yellow-jackets are those distinguished by the beauty of these flexible organs ?

The wasp's antennæ are like those of the bee in structure, each one having a short, stiff handle, or "scape," and a long, flexible

tip, or "flagellum." The scape moves freely at its point of union with the face, by a round ball-and-socket joint, and so serves to change the position of the flagellum, which is composed of numerous small joints covered with hearing and smelling organs of microscopic size.

At least we suppose they are so covered.

Curious little sense-organs certainly there are on the antennæ, and just as certainly the antennæ are the organs of scent,—though it may not be quite so evident they are also organs of hearing.

However, it is believed they are.

There are eleven short joints in the flagellum of the female wasp, and twelve in that of the male.

Besides the organs of hearing and of smell, the antennæ bear a great number of short tactile hairs which are so sensitive that their little owners are doubtless able by means of them to discover the shapes and qualities of objects much more accu-

rather than we could discover them by our blunter sense of touch.

Without the antennæ the wasp would be deprived of the power of finding its food and of doing its work, and would soon perish. It has a keen sense of smell where food is concerned, and quickly finds a savoury morsel by scent alone, as has been proven by concealing meat near its nest.

By means of the antennæ the wasps, like the bees, communicate with one another.

When two meet they at once question each other with their antennæ; if from the same nest, the newest comer is invited to share the honey it probably holds in its stomach, and this it is generally willing to do. If not from the same nest the *Vespæ* generally retreat from each other without the formality of a duel, in this respect showing a much more peaceable nature than bees, for two bees meeting are very

apt to fight at once, if they happen to belong to different hives.

Wasps do not seem to communicate to one another, as bees certainly do at times, the discovery of food; very likely because the wasps are not in the habit of finding large stores in one place. Each wasp hunts its own insect or finds its own flower-cup without feeling any responsibility towards its nest-mates.

Although the wasp has no separate honey-sac like that of the bee, it has a stomach in which it can carry quite a large drop of honey, and this honey it can regurgitate.

Some species of wasps store a sort of honey in their combs, but it is a very poor substitute for the glorious nectar of the hives; and in Brazil a certain wasp manufactures a honey dangerous to eat, as it occasions dizziness and sharp pains in the stomach.

“The naturalist Auguste Saint-Hilaire, during his sojourn in Brazil, himself experienced ill-effects from eating it.”

Hornets and yellow-jackets are fond of sweets, and when a captive *Vespa* is given honey or syrup the office of the antennæ is at once apparent. These delicate threads are turned towards the inviting delicacy, they are gently waved and tilted and balanced as her ladyship moves nearer and nearer, until the delicate tips finally touch the object of interest; all doubt as to its nature vanishes, and *Vespa* at once forgets the sorrows of captivity in long, delightful draughts.

Whoever longs for the fellowship of wasps can make their acquaintance and watch their actions with perfect safety by confining them in a cage made of a cardboard box without a cover and with large openings cut in the sides, the whole covered by wire netting. The care they need is nothing compared to the pleasure and

instruction they may afford, as a daily dewy leaf to drink from, and a lump of moist sugar to stay the pangs of hunger are all the attention they require. The occupants for these cages are caught with an insect net on the flowers the wasps frequent.

Such Vespæ become quite tame, and as, unlike bees, they do not sting strangers of their own kind, any number can be safely put together in the same cage.

WASP-FLOWERS.

THE wasps love the flowers, and from early spring to late fall may be seen flying about them.

They appear to be very exclusive in their tastes, as they are found upon only a few plants, whereas bees may be found upon almost anything that blossoms. This is not due to a capricious appetite, but doubtless to the size of the tongue, for the little flat ligula of the hornets and yellow-jackets cannot reach to the nectary of most flowers.

The wasp is a philosopher, however, who does not waste power worrying over delectable sweets just out of reach.

“Go to!” it seems to say; “there are other flowers, more generous and with equally dainty sweets;” and these it seeks

and joyfully rifles, turning no longing gaze towards the honeyful spurs and cups not open to its enjoyment.

There are certain flowers that may be justly called wasp-flowers, because the head of the wasp and the cup of the flower fit each other so prettily. One of these is the figwort. There are two species of this odd plant in our country, the Maryland figwort, which blossoms later and grows larger, and the early smaller Hare figwort.

These are common weeds that might be passed a thousand times without notice, because the flowers are small and inconspicuous, but when one knows they are wasp-flowers they at once become more interesting.

The figwort grows abundantly where it does grow, and in good soil the larger species attains a height of eight or ten feet, though it is usually from three to five feet tall.

The figwort is quite a charming plant, when one stops to look at it; its clusters of small purple-green flowers, light and airy on their slender stems making a pretty pattern against the sky. But the principal interest attaching to it is in the shape and size of its blossoms.

These little green and purple urns are just large enough to receive the head and chest of a hornet or yellow-jacket, and when the little creatures fit themselves into its accommodating bosom they find its nectar neither hidden nor to be reached only through long and slender tubes, as is the case with so many bee-flowers.

No, this figwort nectar lies within easy reach at the bottom of the little urn, ready to yield itself abundantly to the short flat tongues of hungry hornets and yellow-jackets. And about these flowers on sunny days the hornets and yellow-jackets can always be found.

Bees too visit them, for their honey is abundant, and the bees find them, notwithstanding their dull colours, quite as readily as do the wasps.

But there are many wasps to one bee about the figworts, which at that season of the year are often the only flowers in bloom that yield tribute to wasps, while the bees can satisfy themselves at other fountains.

The figwort is a cunning schemer, whose dainty green or purple urns do not stand filled with nectar with no other purpose than the pleasure of the wasps and bees. They go to it for honey, and this it graciously gives, then makes them the bearers of its pollen grains. To it they bring pollen from neighbouring figworts; from it they bear pollen.

The figwort holds its ripened pistil forth in the passage-way to its banquet hall, and whoever enters must brush the ready stigma. Thus, sooner or later, it is sure

to receive the pollen it desires from its distant neighbours.

Once dusted with pollen the pistil turns down out of the way over the lower lip of the urn, and the stamens then present themselves, ripe and ready to dust the honey-seekers with plenteous pollen to be carried to neighbouring figworts.

This service of pollen-carrying the wasps must perform, whether they like it or not, —and they do not seem to like it, for wasps do not gather pollen for food as do bees, and it is only a nuisance to them.

They often stop to brush it off, but enough grains cling to them to serve the purpose of the flowers visited.

The figwort has a hood over its head formed by the borders of the upper petals; and this is one of the prettiest things about it.

The wasp goes in under this hood, which rises as the bud unfolds, and reveals the opening to the flower urn.

Moreover, when it rains the flower droops a little on its stem, and the hood also draws forward slightly, so as to protect the precious contents of the urn—the nectar and pollen—from the rain.

When the sun shines the flower straightens up, as does also the hood.

In figwort season the laurel too opens, and then do the mountains of its choice blossom like gardens. The observer looks with amazed admiration upon undulating banks of solid bloom walling in the path he treads. Through the openings in these banks, slopes in the distance shine white as snow or glow rosy red. The wilder the mountain, the mightier its outburst of laurel beauty.

The shallow cups of the flowers invite the approach of the wasps, who also frequent the safe recesses of the mountains, where to the branches of the trees they hang their paper homes.

The laurel is not specially a wasp-flower,

though these insects seek its easily reached nectar upon occasion, and no doubt are valuable agents in carrying the pollen which the laurel conceals in a curious and very ingenious manner until the time of its ripening. The stamens are bent over like springs, the anthers being caught in little pockets or depressions in the corolla.

When the wasp seeks nectar its restless legs loosen the stamen springs, and up fly the anthers, throwing pollen as out of a sling, often quite over the bush to a neighbouring plant, and often against the body of the wasp, that, after being pelted with pollen, is in a condition to cross-fertilise the next laurel flower it visits.

The Alleghany *Menzesia* is a plant the wasps delight in. It belongs to the Heath Family, and has a bush like an azalea,

but flowers like those of a huckleberry, though larger.

Indeed these flowers are just large enough to allow the hungry *Vespa* to get her head into the nectar stored at the bottom of the little flower urn.

The *Menzesia* grows in the Alleghany Mountains, and one lovely mountain top in Virginia in the spring is covered with beautiful bushes of it, every flower cluster having its little band of wasp votaries.

The pretty snowberry blossoms that make charming the northern mountains are also wasp flowers. This dainty little plant creeps over mossy banks, and in May and June puts forth the small white flowers that are succeeded by snowy berries having a flavour of birch.

The pretty bell-shaped blossoms are of the right size to accommodate the head of *Vespa*, and she has the good taste to be fond of snowberry honey.

ALLEGHANY MENZESIA

The sweet-clover also yields its delicious nectar to the short tongues of the hornets and yellow-jackets, — a fact of which they are not slow to take advantage, as the visitors buzzing about the sweet-clover beds that line many roadsides bear witness.

Vespa enjoys the goldenrods too, and in the fall of the year may be captured quite easily as she buries her face in the polleny masses, oblivious for once to whoever may be coming near with suspended net and evil intent.

It is commonly said that wasps are attracted to flowers having a disagreeable or meat-like odour.

This may be true to some extent, though it seems probable that the structure of the flower has more influence upon the visits of wasps than the odour. Certain flies do prefer ill-smelling flowers, and the wasps, finding the nectar of these flat-topped blooms obtainable by their short tongues,

may visit them also, though they by no means confine their attention to such.

They may not be quite as dainty as the bees in their choice of food, but it is a libel to accuse them of preferring ill-smelling blossoms if they can find sweet ones.

They are very fond of honey, syrup, and all sweets, and eagerly suck the sap from bleeding trees in the spring of the year.

Like the bees they have a weakness for fermented drinks, and they are immoral enough to abandon themselves to whatever satisfaction comes from intoxication, eagerly drinking sweet wine, or sugar and water containing alcoholic liquor. If their drink is but sweet enough they joyfully imbibe until they are quite drunk. They frequent nature's wine-shops too, drinking the juices of fermented fruits, and after an orgy under a tree whose over-ripe fruit strews the ground, they may be seen lying around in a state of helpless drunkenness.

As they recover they stagger about in a feeble and tipsy manner absurdly suggestive of the members of a higher race when in the same unfortunate condition.

Their misdoings do not prevent their being valuable to the plant world. Probably they are important fertilising agents to all flowers whose nectar their tongues can reach, and it is known that several plants are entirely dependent upon them for cross-fertilisation.

The tongue of *Vespa*, the wasp, differs very much in structure from that of *Apis*, the bee, for the *Apis*' tongue is modified into a long, sucking proboscis, while the mouth organs of *Vespa* are not very much specialised. The upper lip folds down and hides the tongue when the latter is at rest. Below the upper lip is a portion which consists of a four-parted tongue and two feelers, one on each side. Underneath this are two horny parts, which bear each a feeler.

The feelers probably aid the wasp in exactly locating, and perhaps in deciding the quality of, its food. The tongue as a

whole enables it to lick up easily reached liquids, but it is quite unable to reach concealed or distant nectar.

When not in use the tongue is drawn in and back, where it fits in a groove behind the head. When in use it appears as a little flat tongue, so like that of a dog in motion and appearance, as one watches it at a distance, that one is surprised and de-

lighted with the first view of a wasp dining in captivity. It is very difficult to see it dining excepting in captivity, as the social wasps are usually so wary that one cannot get near enough to watch them on the flowers out-

of-doors. In nest-making time, however, when they are engaged in cutting up insects or bits of meat for transportation they become so oblivious to the rest of the world that one can not only watch them at short range, but even clip their wings.

VESPA'S FOOD SUPPLY

WHILE in the spring and early summer Vespa lives largely upon nectar, she is not at all conservative upon the food question. All is fish that comes to her net. She is decidedly omnivorous, even enjoying cooked food when she can get it. She often flies into dining-rooms and kitchens and helps herself to what she finds; an informal assumption of unoffered hospitality that gives her more pleasure than any one else concerned.

Later in the season she sucks other people's fruit juice with the same optimistic disregard of property rights, and with her sharp jaws cheerfully punctures and then eats the choicest spot on the juiciest, ripest, and best fruit that the orchard affords.

The best is none too good for a wasp, she believes, and lives up to her faith.

The fruit-grower thinks otherwise and looks with eyes of wrath upon the white-and-black, or yellow-and-black imps that ruin his best fruit and sting him if he presumes to interfere.

Sometimes the wasps eat all the pulp from a specially attractive fruit, though too often their epicurean tastes are content only with the best of a pear or an apple, taking out enough to spoil it and leaving the rest. Almost every one has had the experience of picking up what looked like a perfect pear or apple and finding it a mere shell filled with wasps. Such an apple was once given a shake, when out through the single hole that gave entrance to the interior came a tail wildly brandishing a sting, ready for business. After the tail came the rest of the wasp, who, once fairly out, flew about her affairs without molesting the hand that held the apple. After this successful exit came another tail brandishing a fiery dart,

and after this another and another, until a dozen or more wasps had sallied forth tail first in a triumphant, touch-me-if-you-dare procession.

Since the cause of their disturbance was out of sight the clever wasps, fearing to come out head first and thus put themselves at disadvantage to a possible foe, preferred the exercise of military tactics that though simple were sufficient.

Vespa requires strong jaws, for with them she does most of the hard work of a wasp's life, from cutting up solid food to chewing wood fibre into paper pulp for nest-building purposes.

And they are strong, large, toothed and horny in substance, joined to the sides of the head below the eyes, and, as is usual in insects, working sideways.

She likes to vary her diet of fruits and sweets with an occasional insect, which

she is very skilful in catching. She is particularly fond of flies, though nothing seems to come amiss, and she bears out her reputation of liking ill-smelling food by devouring the malodorous white cabbage butterfly and the offensive earwig, both of which are left severely alone by even the hungriest of insectivorous birds. She also likes raw meat, to which she willingly helps herself from the butcher's shop, without troubling him to wait on her. The butcher ought to welcome her, as the small amount of meat she consumes is more than paid for in the large number of flies she catches, thus protecting him from one of the greatest nuisances he has to contend with. But butchers are not always grateful for their blessings, and one once clipped the wings of the wasps engaged in carrying off his meat, to punish them for the theft. Never before had they been obliged to face such an emergency, and finding themselves unable to

fly, their wasp minds, searching for a cause and relying upon past experience to supply it, naturally concluded they had carved out too heavy a steak, and they set to work cutting their pieces of meat smaller and smaller. Poor little fellows! What happened when the fragments had been reduced to the smallest possible size and the wings still refused to perform their office, the record does not state, but surely there was material for tragedy in the annals of waspdom.

Besides eating animal food herself, *Vespa* carries it home to feed the larvæ in the nest.

Wasps doubtless deserve far more credit than they usually get for their services as fly-catchers. Mr. Wood, in his "Homes without Hands," tells of pigs lying in the warm sunshine covered with flies which wasps pounced upon and carried away.

Another observer watched wasps catching flies on two cows, and in twenty min-

utes saw between three and four hundred snatched off.

It is to be hoped the cows were properly grateful.

In some parts of our own country, farmers' wives are reported to have taken advantage of the wasp's well-known fondness for flies by hanging a wasp's-nest in the house. Doubtless such a fly-trap, with a little care and patience, would work admirably, as wasps readily make friends of people whom they are in the habit of seeing close to their nests, and who do not molest them. However, the present writer does not seriously recommend the practice as a substitute for window-screens and fly-poison.

No doubt the wasps do a great, though unrecognised service, in keeping the flies in check, as was once proved on an estate in England, where all the female wasps were hunted and killed one spring before they had a chance to start their

nests. The wasps were sacrificed in order to save the fruit in the fall from their depredations. The fruit was spared, but for two years the estate "was infested, like Egypt, with a plague of flies."

Doubtless wasps are valuable scavengers in hot countries, where they are very numerous, and where they have been known to consume large quantities of refuse, and even to keep the butchers' stalls sweet and clean. In our country the wasps that live near human habitations do their share as scavengers. Once these little insect vultures were observed to clean

the bones of a dead mouse in two days.

An interesting writer in a British periodical tells of sitting in the open air and being visited by wasps that wished to share his lunch. The first day they were some time finding the lunch-bag, but the next day they recognised it and their entertainer, and were on hand

clustered on the bag ready for the feast before there was time to undo the strap. Some bread and jelly and a small piece of bacon and butter were hung on the hedge to lure away the rather inconvenient guests, and these things they caused to disappear,—all but a small piece of hard bread.

The same observer found a great difference in wasps near dwellings and those living in the deep woods. The latter took no interest in lunch-bags, not having had experience with food prepared by man, and they were not inclined to make the acquaintance of their human guest. Those living by the roadside, however, visited him as he sat painting, getting on his collar and his arm and even allowing him to stroke them gently on the back.

Indeed wasps differ as much as cats in their habits of friendliness. One cannot make friends with a puss that has run wild

in the woods, perhaps was born in the hollow of a tree, as one can with a household pet. Neither do the wasps of the forest become friendly like those of the wayside.

A yellow-jacket's nest was once built in the ground on a vacant lot in a large city. People constantly passed within three feet of it, and mischievous boys had stoned the entrance to the nest until there was a little mound of stones to mark the spot. The wasps rushed out when stoned and stung the boys, but they never molested a passer-by under ordinary circumstances. Indeed one could stand close to the nest and watch them hurrying in and out, whizzing past one's head back and forth, showing no resentment and paying no attention to their visitor.

If one wishes the sensation of taking a live hornet in the hand, it can be safely done by putting a drop of syrup on the end of the finger and offering it to a

hungry caged hornet. One should move gently, slowly, invitingly, and her ladyship, forgetting all cause for resentment in the joy of discovering food, will climb in a friendly way upon the offered finger; and no wasp is ever dastardly enough to sting a finger upon which it voluntarily and in a calm frame of mind has climbed, that is, unless it becomes frightened before it leaves of its own accord.

It is never safe to frighten hornets.

Sometimes her ladyship finds the warm finger attractive for its own sake, and particularly on a chilly day will sit contentedly panting her abdomen after the syrup is eaten and the holder is quite ready to end the experiment and return the wasp to her cage.

This can be done by gently placing a slip of paper in front of her and shoving her off the finger, or if the nerve fails, a quick flip will safely dislodge her.

In dealing with hornets the main thing is to be perfectly calm and self-possessed. A nervous thrill of fear seems to be communicated by some occult process to Vespa's nerve centres as well, and a frightened hornet is always a fighting hornet.

LEGS AND WINGS

SIX is the allotted number of legs in the insect world, and this number has Vespa. They, with her wings, are borne by the compact thorax, whose value in insectdom is principally for affording points of attachment to the organs of progression, and a place of support for the muscles that move those organs.

Like the bees, the wasps are eternally making their toilet.

Vespa, like a neat old tabby-cat, washes her face and hands with her tongue. She puts her paws, so to speak, in her mouth and licks them clean, then while they are presumably still damp, she draws them over her head, turning that important part of her diminutive person this side and that, very much as puss does when performing the same office.

Vespa cleans her wings, thorax, and abdomen with her legs, like a bee, but she is not so particular about her hinder parts

as is my lady the bee. It is not necessary, as she is a hard and polished person, encumbered with but few hairs, and those not of a dust-catching structure.

Her precious antennæ receive a great deal of attention, and, like the bee, she has implements on purpose to clean them.

Her antenna cleaners, though not so well-finished as those of the bee, resemble them in structure.

In the bend of the fourth and fifth joints of each foreleg is the cleaner.

It consists of a little flattened prong or valve hanging from near the lower end of the fourth joint and of a curved groove at the upper end of the fifth joint.

This groove is fitted with a circle of teeth.

When the antenna is to be cleaned, the leg is raised above it, the antenna is slipped along until it rests in the groove, then the leg is flexed, the valve or prong fits down over the antenna, and as the latter is pulled through, the edges of the valve on one side, and the teeth of the groove on the other, clean it perfectly.

Vespa is particularly fond of exercising these clever little arrangements for keeping the antennæ in order, and whenever she is at rest may be seen giving frequent dabs at her face, first one side and then the other, each time drawing an antenna through its cleaner. She seems to do it unconsciously while she sits meditating, as some people pull their moustaches or twist their hair. Occasionally she makes a careful and prolonged toilet, scraping and pulling her antennæ many times in succession.

Besides these admirable instruments for toilet purposes, there is a pair of sharp

prongs on the lower end of the fifth joint of Vespa's middle and hind legs, and these are used in cleaning the legs and wings. The wasp is very skilful with them, evidently understanding perfectly their value as articles of the toilet.

Otherwise Vespa's legs are not remarkable. She does not use them for pollen gathering, and so lacks the pollen-collecting implements of the bee, and she does not use them to any great extent in nest-building, — that important and interesting work being performed principally by her jaws and tongue.

Vespa goes whizzing through the world propelled by wings that in themselves do not appear capable of sustaining her weight in the air. Nor were they capable but for the powerful motor that impels them with such force and skill that they are apparently able to defy the attraction of gravitation, and spurning the earth bear her aloft in the air.

The power that gives them their great force is found in certain thoracic muscles that throw the wings into such rapid vibrations they are able to play the part of aërial propellers, and away goes *Vespa*, merrily humming as she speeds along.

In structure and movement the wings of the wasp are similar to those of the bee.

Like the bee, she has four of them, two on either side of the thorax and attached about half-way from the head to the abdomen, — attached, one may be sure, at the point best to maintain the balance of the body when it is held suspended in the air.

The front wing is the larger, and the two are attached close together.

That these two wings may effectually act as one, they are, like the bee's wings, hooked together. Along the upper edge of the lower wing toward its outer mar-

gin, is a row of hooks that fit into a groove running along the under edge of the upper wing.

When the hooks are caught in the groove the wings are so closely locked together that the two look and act like one.

The wings of the true wasps differ from those of the diggers and of the bees by being folded, fan-like, down the middle.

This fold occurs in the large wings, and when the wasp is at rest with her fans closed she has an exceedingly slender and elegant-looking pair of wings lying along the sides of her body.

This lengthwise folding of the wings is convenient when *Vespa* crawls about the narrow spaces of her nest, and it more effectually disposes of them when they are not wanted than the bee's method of unhooking hers and slipping the under ones out of the way below the upper ones. *Vespa* does not seem to unhook her wings

when at rest, but folds the under ones over at the joint without unhooking them. So her wing is in reality folded together like a little fan of three "sticks."

Vespa hums as she flies, the sound being due to the rapid vibrations of her wings. At home, however, she is silent, her nest is not buzzing with happy industry; it is quiet with happy industry, and even when disturbed gives forth no such threatening murmur as pours from a disturbed bee-hive. There is excitement enough within, however, and out rush the frightened occupants, as eager to inflict punishment as though they had been as noisy in their wrath as their relatives.

When a wasp flies about one's face in an angry frame of mind it buzzes with loud vehemence, but as a community the Vespæ rage in silence.

Like the bee, the wasp has a voice besides that made by the wing vibrations. If she

is held between the thumb and forefinger by the thorax, the operator being careful what she is doing with her sting end meantime, a very distinct vibration of the whole thorax is felt. Indeed the head and the upper part of the legs share these curious motions, and a high-keyed buzzing is heard even when the wings are not moved at all.

Like the bee the wasp's "spiracles" or openings to the air-cavities in thorax and abdomen contain vocal organs, particularly those in the thorax, and when these are thrown into vibration they give rise to the shrill outcry of the captured insect. In the air-cavities of thorax and abdomen the blood is aërated as our own is in our lungs.

Concerning *Vespa's* voice, Moffett, an early English writer, in his entertaining "Theatre of Insects," says, —

"They make a sound as Bees do, but more fearful, hideous, terrible, and whistel-

ing, especially when they are provoked to wrath."

Evidently Mr. Moffett had had experience of them when "provoked to wrath," and possibly the memory of their stings made him think ill of their voices.

VESPA'S STING

VESPA'S abdomen is joined to the thorax by a very slender attachment, though this is not apparent to the casual observer, as the broad, blunt end of the abdomen usually conceals the slight thread by which it is held in place, and makes the wasp look like a much stouter and more substantially built creature than she is. The true form shows best in a dead Vespa, which is usually curled up.

Moffett says in his quaint way, —

“The body of the Wasp seemeth to be fastened and tyed together to the midst of the breast, with a certain thin, fine thread or line, so that by this disjoyned, and not well compacted composition, they seem very feeble in their loins or rather to have none at all.”

Most of the wasp's organs of digestion are packed away in the abdomen, and here is the capacious stomach. At the tip of the abdomen is the wasp's serviceable weapon which is also, in the queen, the ovipositor or egg-placer.

The wasp, like the bee, carries its sting in its tail, or, as Moffett vividly expresses it, "Their taylor is armed with a long, stiffe and exceeding venomous sting," and concerning the efficiency of this weapon there is but one opinion.

From early ages to the present time the "fiery darts of the wasps" have furnished illustrations of invincible attack; as when Homer, in the Iliad, speaking of the valour of the Greeks, causes one of the enemy to exclaim amazed, —

"I did not look to see the men of Greece
Stand thus before our might and our strong arms;
Yet they, like pliant-bodied wasps or bees,
That build their cells beside the rocky way,
And quit not their abode, but, waiting there

The hunter, combat for their young — so these,
Although but two, withdraw not from the gates,
Nor will, till they be slain or seized alive."

Virgil speaks of the "fierce hornet" as destroying bees, and Ovid tells how bald Silenus undertook to rob a nest of hornets, supposing they were bees. Out flew the furious insects and sat them down upon his bald pate and stung until he fell down screaming for help. Bacchus appeared upon the scene and mercifully plastered mud upon the wounds,—the remedy still in vogue, and probably the only one worth trying.

It is well to remember that wasps are always more active and eager to sting in hot weather and when the sun shines. He who wishes to take a wasp's-nest, will fare better to wait for a cold, damp day when the insects are too chilly to be properly resentful.

In the Bible the Lord uses the hornets to help clear a way for the chosen people.

“Moreover, the Lord thy God will send the hornet among them, until they that are left, and hide themselves from thee, be destroyed.”

Again it is written, —

“And I will send hornets before thee, which shall drive out the Hivite, the Canaanite, and the Hittite from before thee.”

And in a brief history of God's benefits to the children of Israel it is narrated, —

“And I sent the hornet before you, which drove them out from before you, even the two kings of the Amorites.”

In “Cruden's Concordance,” in the introduction to the subject of hornets, we read that “A Christian city, being besieged by Sapoors, king of Persia, was delivered by hornets; for the elephants and beasts, being stung by them, waxed unruly, and so the whole army fled.”

Not only have armies been dispersed, but cities have been abandoned because of the fierce onset of the hornets. Moffett says, —

“If we will credit Ælianus, the Phasilites, in times past, were constrained to forsake their City, for all their defence, munition, and Armour, all through the multitude and cruel fierceness of the Wasps, wherewith they were annoyed.”

So far from blaming them for thus tormenting the Phaselites, Moffett magnanimously and humorously adds, —

“Again, this manifestly proveth that they want not a hearty and fatherly affection, because with more than heroicall courage and invincible fury they set upon all persons, of what degree or quality soever, that dare attempt to lye in wait to hurt or destroy their young breed, no whit at all dreading Neoptolemus, Pyrrhus, Hector, Achilles, or Agamemnon himself, the Captain General of all the whole Grecians, if he were present.”

The following story corroborates Moffet's estimate of the valour of the wasps.

“Eight miles from Grandie the muleteers suddenly called out ‘Marambundas! Marambundas!’ which indicated the approach of wasps. In a moment all the animals, whether loaded or otherwise, lay down on their backs kicking violently; while the blacks and all persons not already attacked, ran away in different directions, all being careful, by a wide sweep, to avoid the swarms of tormentors that came forward like a cloud. I never witnessed a panic so sudden and complete, and really believe that the bursting of a water-spout could hardly have produced more commotion. However, it must be confessed that the alarm was not without good reason, for so severe is the torture inflicted by these pigmy assailants that the bravest travellers are not ashamed to fly the instant they perceive the host approaching, which is of common occurrence in the campos.”

Aristophanes’ well-known comedy “The

Wasps," bears testimony to the popular reputation of Vespa.

The comedy is a satire upon the tendency of the time to inordinate lawsuits, and upon the character of the *dicasts* or jurymen of the period. A dog is tried for stealing a piece of cheese, and the dicasts are habited as wasps.

"Have a care what you do; they're a sharp, angry crew, quick as wasp's-nest, when urchins molest it," is the significant warning against the horde of dicasts in the second act.

And the chorus informs us at the end, —

And still, they say, in foreign lands, do men this
language hold,
There's nothing like your Attic wasp, so testy and
so bold."

In modern times there is no lack of stories of outrages committed by hornets upon inoffensive humankind, though from the hornet's point of view there no doubt

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was sufficient provocation for every attack, notwithstanding Ælianus' assertion about the wasps that "by nature they are great fighters, eager, boysterous, and vehemently tempestuous."

Our hornets are pleasant enough when let alone, but they will not bear an injury with patience, and Moffett is quite right when he says, —

"Whosoever dare be so knack-hardy as to come near their houses or dwelling places, and to offer any violence or hurt to the same, at the noyse of some one of them all the whole swarm rusheth out, being put into an amazed fear, to help their fellow-citizens and do so busily bestir themselves about the ears of their molesters, as that they send them away packing with more than ordinary pace."

The hornets of Eastern countries are larger than those of our own part of the world, and seem to have a hotter temper, so that travellers in the East have often been

driven from their positions by this small but valiant foe.

Although it may not be true, as was believed in Pliny's time, that three times nine stings will kill a man, yet there is no doubt that a sufficient number of infuriated wasps, attaching themselves to one person, can deprive him of life. In India, where the wasps are very abundant and very fierce, a party of engineers, while surveying a railroad on the banks of the Jumna, was once attacked by a colony of hornets, when two of the surveyors were stung to death and several others were severely injured.

The hornets of Shahjehanpoor, however, take the prize as conquerors, for they defied the British army, and for one season held possession of government store-houses where sugar was kept.

During their time of occupation no one dared enter the buildings, and when late in the season the hornets yielded, not to

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man, but to the hand of death that slays all wasps in the fall of the year, it was found they had consumed nearly three thousand pounds of Her Majesty's sugar, leaving piles of cotton bags chewed full of holes and stuffed with the bodies of defunct hornets.

But the hornets of Shahjehanpoor do a service to the British Government which no doubt more than compensates it for the raid they made on those sugar stores, for they act the part of scavengers and keep the vicinity of the butchers' booths clean.

One has to admit that oriental hornets do seem a trifle precipitate, and perhaps even a little ugly in the use of their stings. Dr. King, of Penang, reports of one: "He is very vicious, and we are all in great fear of him. No later than last Sunday one flew into the Scotch kirk, where one of the merchants was reading the service, plumped down and stung him instantly

on the head, and was off again in a moment. The sting drew blood, besides being excessively painful. I was once stung by two of them while riding at a foot's pace by their nest, on the back of the head. The pain was most severe. Tenderness down the neck and in the part remained for more than two weeks afterwards."

That was too bad, and seems quite excusable; still, the hornets doubtless would argue that Dr. King had no business to be riding so close to their nest; and as for the one that behaved so shamefully in the kirk, what proof have we that bad little boys, who had not gone to church, had not been stirring up the hornets, and enraged them to the point of being glad to sting any human head they could reach?

At least the hornets that drove Lord Clyde's army into the river were excusable, as they were first attacked by the soldiers.

It seems that—"A picket of Lord Clyde's army were amusing themselves throwing stones at an odd-looking mass of mud and straw hanging on a tree. One marksman, more successful than his comrades, sent a stone with great effect into the centre of the mysterious object, when out flew a cloud of hornets and drove Lord Clyde's invincibles into the river."

The sting of the wasp is like that of the bee in structure and action.

It is composed of a sharp-pointed sheath with a lengthwise groove on one side, into which are fitted two barbed lances that play up and down in the groove.

The lances are moved by a system of levers composed of flat horny plates connected to the upper end of the sheath and lances and controlled by muscles.

The sheath is also barbed at the end so as to hold the sting in place while the lances are being thrust deeper and deeper into the skin.

A poison-sac communicates with the upper end of the sting, and from the sac the poison is pumped into the wound by the motion of the lances.

The sting of the wasp is very sharp and very small, and it is the poison pumped into the wound rather than the wound itself that causes the unpleasant consequences of a wasp sting. The sting, if unpoisoned, would cause no more pain than the prick of a fine needle.

Usually the wasp, like the bee, loses its sting when it plunges that weapon into an enemy. The barbs that point backwards hold the sting fast, and the effort to pull it out often results in tearing the sting from the wasp's body, and as a consequence of the mutilation, the insect soon dies. The larger hornets are often strong

enough to withdraw the sting uninjured, and where this is the case they do not hesitate to use it again and yet again.

Where the sting is left in the wound it should be removed at once, as the muscles that are torn away with it continue to contract and to pump the poison into the wound.

The wasp, like the bee, has two little feelers attached to its sting, and these it first protrudes as though to examine the object before inserting the sting.

Probably these feelers are useful in finding the exact spot in the cell where the egg is to be laid.

Claudius Ælianus, a Greek writer of the second century, tells us that the people of his time believed wasps found a dead serpent and with its venom poisoned their stings, just as human barbarians poison their darts by dipping them into some venomous substance.

He also informs us that the wasps

sharpen their stings by friction, as we sharpen a knife by rubbing the edge against an oil-stone.

According to Ælianus too, the wasp did not always find its sting capable of preserving it from harm, for the wily fox out-witted the angry *Vespa* and ate up its nest. Moffett has thus translated the story in his own picturesque style:

“Reynard the Fox, likewise, who is so full of his wiles and crafty shifting, is reported to be in wait to betray Wasps after this sort. The wily thief thrusteth his bushy tail into the Wasp’s nest, there holding it so long until he perceives it to be full of them, then drawing it slily forth, he beateth and smiteth his tail full of wasps against the next stone or tree, never resting so long as he seeth any of them alive; and thus playing his Fox like parts many times together, at last he setteth upon their combs, devouring all that he can finde.”

STARTING THE NEST

THE well-known grey structures wasps build in trees, under the eaves or in the ground, are generally seen in the fall of the year. Then the leaves have left the tree branches bare disclosing the nests so carefully hidden under the foliage in the summer time.

Moreover, in the fall of the year, boys fearlessly take down these nests and hang them up as ornaments in the house.

Boys do not take them down in the summer—for a very good reason; but they know that after the first frost the nest has no fiery occupants to defend it; it is an abandoned domicile—safe booty for whoever finds it.

Sometimes a hornet's nest is nearly as large as a bushel basket, but that is at the end of the season. The beginning of every

nest is simple enough, and consists of but a cluster of three small cells.

Early in the summer the females of the social wasp may be seen flying about, searching everywhere for a good building-site.

One is suspicious that Madam Vespa uses this nest-hunting as excuse for a prolonged lark, seizing the opportunity to investigate her little universe, and find out a great many things besides the best location for a home. The large yellow queens of the yellow-jackets, may be seen flying about in the spring, peering into every cranny in the woods, investigating every fallen log and heap of rubbish, poising on vibrating wings under the eaves of buildings, examining every growing tree, bush, or herb, and what is more noticeable, examining with equal minuteness any human brother who happens to be abroad. Certainly they do not intend to suspend a nest from any part of your person, yet

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they favor you with as prolonged and careful an examination as they give to any tree, or rock, or roof.

If the windows are open they are sure to come into the house; then they are in a state of consuming curiosity. What does everything mean? They examine each article of furniture in a comically thorough manner, flying around and behind it, and hanging buzzing so close to it that they seem to be testing its quality with their antennæ. Sometimes it is but one or two objects that thus occupy them, sometimes one of them will remain an hour in a room satisfying herself concerning every object in it, not slighting any quiet and inoffensive occupant that may be there. Indeed the human owner of this strange nest seems oftentimes to puzzle her more than all else, and if one but keeps still she proceeds upon a very flattering inspection, — very likely poisoning directly in front of one's eyes, so close that

the breeze made by her little wings can be distinctly felt. Her small face is close to yours, her large eyes gazing intently into your own ; and there she hangs while you, flattered by her close attention, sit and look calmly back at her or close your eyes until the close buzzing of her ladyship ceases to roar in your ears. One living in a region of wasps becomes quite familiar with these spring visits, and at least one person feels slighted if Queen Vespa enters the room and goes out without noticing its human occupant. It is unnecessary to say that wasps under such circumstances never sting. They are simply about their business, trying to get an education out of the only book at their command. In a few weeks these large yellow queens disappear. Other, smaller, less prodigally yellow creatures roam the fields, but the large queens are absorbed in domestic duties that keep them within their doors.

The queen-hornets also intrude their

black-and-white presence in people's houses in the spring, but they do not seem so curious nor so friendly. Their investigations seem rather aimless, in comparison with those of their yellow relative, and their manner is much more suspicious and, if one may say so, tempestuous.

Only the perfect females or "queens" of the Vespæ survive the winter, and when they are wakened to life by the warm sun of early summer, each little queen wasp has upon her shoulders the responsibility of the whole family,—she must build her own house as well as take care of her own offspring. She does not start in life, like the queen bee, with thousands of helpers ready to do all the work and even to feed her royal highness.

She must do everything for herself, at least at first.

When she has found a place to her mind, perhaps in the branches of a tree, or under the projecting eaves of a build-

ing, or in a hole in the ground, Vespa betakes herself to a grey and weather-worn rail, or to an old stump, and there

she sits and gnaws lengthwise of the grain until she has a little bundle of wood-fibre in her jaws.

This she takes to her chosen site and chews into pulp, mixing it with saliva from her mouth.

Now behold the first paper-maker of the world at work !

For the social wasps were making a serviceable paper ages and ages before man dreamed of such a thing.

When the Egyptians were laboriously cutting their records in stone, or drawing them up on the pressed pith of the papyrus, and the Europeans theirs on the inner bark of trees, and the North American Indians were tanning the hides of animals and painting their messages upon them, the wasp folk were busy making a

true paper, a paper that man finally learned to make, in essentially the same way that the wasp makes it.

For paper is only vegetable fibre reduced to pulp and pressed into sheets.

Having gathered her little ball of wood-fibre, and reduced it to a pulp of proper consistency by chewing and moistening with sticky saliva, Vespa first builds a slender stem or support for her future home.

To the end of this she hangs a little cluster of three or more hexagonal cells, also of paper.

She begins at the roof and builds down, suspending her habitation from above, instead of building it on foundations that rest on the earth.

She begins her first cell, but does not finish it before she starts another, and when she has a cluster of three half-finished cells she lays an egg in the first one, and goes on building. As fast as the

cells are large enough she deposits an oblong white egg in each, placing it in an angle of the cell and about one half or two thirds down, or what will be one half or two thirds down when the cell is finished.

Her cells are six-sided, and are like honey-comb cells, excepting that they are made of paper instead of wax, and are suspended mouth down instead of lying on one side.

Since the cells hang mouth down, one naturally wonders why the eggs do not fall out as soon as put in.

The reason is that each is covered with a sticky substance, so that it is glued firmly to the cell wall.

The ancients had as little idea of the origin of wasps as they had of the origin of bees, and while they believed the bees were bred from the decaying carcass of a bull, the wasps, they tell us, came from the dead body of an ass or a horse, the fierce

swift hornets owing their origin to the body of a war-horse.

There was also a superstition among the Egyptians that wasps were generated from the decaying carcass of a crocodile.

However, a later generation discovered that wasps proceed from eggs laid in the cells of the nest by the queen wasp.

The egg is generally placed in an inner angle of the cell, and is attached by one end.

Her first three cells completed, *Vespa* starts another row of cells around them, depositing an egg in each as soon as it is ready.

She evidently does not consider these exposed cells a safe resting-place for her progeny, for no sooner has she formed a little group of nine or a dozen cells than she proceeds to make a paper wall about them.

The result of her labours is a pretty little grey ball, with a hole

in the bottom, enclosing the group of cells, but not attached to them. The first wall made consists of but one layer of grey paper, and at that stage the nest looks its prettiest.

Vespa finally devotes all her time to caring for her progeny, for in a few days the first eggs laid have hatched into tiny white maggot-like larvæ, and every day more eggs hatch out. Queen Vespa is obliged to go hunting food for these ravenous infants. They are still attached

to the side of the cell by the tail end, but their mouths are free, and are always ready to open for something to be put in.

They have little round white heads, with little pin points of eyes and a pair of tiny, brown, horny jaws. The eyes of the larva are simple, the compound eyes not appearing until the adult form. When the comb is jarred, out are

thrust all these little heads, and the mouths are opened wide, for they suppose that Mother Vespa is coming to feed them.

When a number of the eggs have hatched, Vespa devotes most of her time to catching flies and other insects, chewing them up and feeding the hungry youngsters in the cells with them.

One is reminded of a mother bird feeding her nestlings, when watching the mother wasp going from cell to cell, and putting food into each little open mouth.

The larvæ are always ready to open their mouths, and it is no wonder they are forever asking for more, as they grow at a marvellous rate, in the course of a few days filling their cradle cells with their plump, white bodies.

One trying ordeal every young Vespa has to pass through, and that is the change of position in its downward-opening cell. Since the egg is glued to an angle of the cell part way down, when it hatches, the

larva grasps the cell with two little feet at the end of its tail, at the same spot where it was hatched. As it grows larger, however, it must manage somehow to reach the bottom of the cell, so that it may have room to continue its growth.

This migration to the bottom of the cell necessitates turning around twice, letting go its hold on the side of the cell, and yet keeping its position in the downward-pointing cell so as not to fall out.

If the difficult feat of letting go, turning around, and moving to the bottom of the cell is accomplished, all is well.

But sometimes it is not accomplished. Poor baby *Vespa*, using her still useful tail-feet and her jaws to hang on by, slips or makes a miscalculation, and out it tumbles head over heels.

It is said the mother wasp sometimes puts it back after such an accident, but generally it lies and wriggles in the cold outer world until death claims it.

Or if it falls out later in the season the worker wasps carry it out of the nest and leave it to perish.

But if it once gets fixed in the bottom of the cell, with its head hanging down, all it has to do is to stay there.

This may look difficult, but it is really easy, for young *Vespa* is now a fat, white grub, or larva, with a brown head, footless, it is true, but with a way of ruffling up the sides of its body that enables it to fit tightly in the cell and there remain.

When the larva has reached the limit of its growth it finds its mouth full of silk.

This comes out through a hole in its lip, and whenever it touches anything with its mouth little viscid threads like saliva are drawn out, and these harden into a fine, glistening silk.

Now young *Vespa* ceases to crave food. She touches the side of her cell with her mouth, draws back her head, touches another part of her cell, draws back

her head,—each time pulling out sticky threads that harden into silk.

Thus moving her head about, she lines all but the bottom of her cell with soft, tough, white silk; then she reaches out her head and weaves back and forth, back and forth, over the opening to her cell, until she has formed a strong cap or roof over her head. From the very beginning she has more responsibility than the young bee; no fond nurse seals the opening to her cell, she is obliged to do that wholly for herself. The cap made, the infant is now lying in a silken bag of her own manufacture, open at one end and closed at the other with a cap of silk that is heavier than the silk used in making the rest of the bag.

Her cocoon, if such it can be called, is much heavier and stronger than the similar covering the young bee makes for itself.

She is now safely wrapped up, her silk covering preventing the too rapid evaporation of the juices of her body.

Lying there motionless, a marvellous change comes over her. She loses her fat larval form, a waist line appears, below it is a ringed abdomen, above it is a thorax with incipient legs and wings, and a waspish-looking head.

She is now a "pupa," and at one stage of her transformation is a very charming little creature, as she is as white as snow, and has the daintiest legs and antennæ lying close to her body.

As time goes on, however, she grows darker-coloured until finally a perfect wasp lies in the silk-lined cell.

During her larval life *Vespa* sheds her skin as she increases in size, and finally, throwing off the last delicate covering from her pupal body, she is ready to step forth into the world and see what is going on there.

She reaches out her jaws, which are much larger and stronger than the brown dots of jaws she possessed as a larva, and with them cuts a hole in the cap she spun over her head a few days ago. As she works she moistens the spot with saliva.

Snip, snip, snip, go the jaws in the dark cell.

One can easily hear them at work. Then a little opening appears. Snip, snip, snip, go the jaws until the hole is large enough to let out one of the antennæ.

This organ, newly freed from confinement, waves about as though examining the world into which its little owner is about to enter.

But the jaws are still snipping, and finally the cap is so nearly cut away that Vespa's face can be seen filling the opening of the cell.

Then a foot appears, a fore-leg is stretched out, and very likely the first thing it does is to clean the antenna.

It is very amusing to watch a young *Vespa* coming out of its cell, tucked away, all but the head and fore-legs, and industriously cleaning its face and hands and polishing up its antennæ.

It takes its time, and when it has rested from the effort of uncapping its cell, and has thoroughly made the toilet of its head and hands, it begins to pull itself out.

It grasps the surrounding comb with its fore-feet, and struggles until it has pulled out its second pair of legs.

The remainder is easy, and in a moment more a shining young wasp stands on the comb and surveys its surroundings.

FINISHING THE NEST

THE first wasp that emerges from a nest is not a queen.

It is smaller than the queen-mother, is not so brightly coloured, and is called a “worker.” It is an imperfect female, unable, as a rule, to lay eggs. The first thing it wants is something to eat, and this the queen-mother gives it.

It very often hides away in an empty cell for a while, as though to rest, or “think it over.” When it goes into a cell it now does so head first, with only its tail protruding.

The time for development from egg to imago, or perfect insect, seems to vary, perhaps according to the species, perhaps according to the temperature. One observer reports his wasps as five days in the egg, nine in the larval state, and thirteen in the pupal state, — twenty-seven days in

all. Another, his as eight days in the egg, twelve or fourteen in the larval state, ten in the pupal, — thirty-one or thirty-two days in all. As a rule, it probably takes about a month to complete the development.

All of the wasps hatched early in the season are workers, and as soon as they come out of their cells they prove their right to the name, for they take upon themselves the whole work of the nest.

The queen can now devote her time to egg-laying, for the young workers clean out the cells and make them ready to receive another set of eggs. They also enlarge the comb by building more cells.

They fly to a weather-beaten rail-fence or to an old stump, and there they stand and gnaw lengthwise of the grain until they have a little ball of wood-fibre, with which they fly home. They chew it thoroughly, wetting it with their sticky saliva, and then proceed to shape it into more cells.

Nobody tells them how to do all this, but they remember, somehow, that their mother did it this way before they were born.

Young Vespa lays down pulp for a roof, then builds the cell walls by adding strips of pulp at the edges and biting them into shape.

As she stands on the rim of an unfinished cell, adding pulp, the walls rise slowly, and soon a little six-sided cell testifies to her skill as a comb builder.

One sometimes has a chance to see the yellow-jackets at work on a nest that has been destroyed—or where an attempt has been made to destroy it. If any of the little occupants escape destruction they will return to the old place and start the nest again, building it up, or rather down, from the foundation if necessary.

One should be on hand as soon as the agitation following the removal of the nest subsides enough to make a near approach

safe, or else the first cells will have been built, and the whole enclosed in an envelope that completely conceals what is going on inside.

As soon as the workers of an undisturbed nest begin to come out, they go to work upon the walls of the nest, adding layer after layer, until sometimes there are a dozen or more.

Quickly the little nest made by the mother wasp increases in size, when all is well with the swarm.

But there seem to be a great many vicissitudes in the lives of the hornets and yellow-jackets, and one may often find in an out-building a dozen of their little round nests, begun but never finished.

Doubtless something happened to the queen before her first brood was hatched. A greedy bird may have swallowed her, a boy may have killed her, she may have fallen into the water and been drowned, or

there may have come a cold, rainy spell to which she succumbed, for wasps are delicate creatures and perish in large numbers during a bad season. Indeed, they are more dependent upon fair weather for their success in life than are many less hardy-looking animals.

Even where the brood has begun to hatch, if the queen is lost the workers soon abandon the nest.

Wasps can often be watched at work on the outer covering of the nest.

To pursue this particular line of observation, it is well to select a cold and cloudy day, as the wasps are then not so easily excited.

Dr. Ormerod, who spent a great deal of time studying wasps, has well described the method of nest-building as follows:

“When a wasp came home laden with building materials, she did not immediately apply these, but flew into the nest for about half a minute, for what purpose

I could not ascertain. Then emerging she promptly set to work. Mounting astride on the edge of one of the covering sheets, she pressed her pellet firmly down with her fore-legs till it adhered to the edge, and walking backwards, continued this same process of pressing and kneading till the pellet was used up, and her track was marked by a short dark cord lying along the thin edge to which she fastened it. Then she ran forwards, and, as she returned again backwards, over the same ground, she drew the cord through her mandibles, repeating this process two or three times till it was flattened out into a little strip or ribbon of paper, which only needed drying to be indistinguishable from the rest of the sheet to which it had been attached."

Dr. Ormerod also discovered that each wasp has not a place of her own at which to work, but that all work anywhere and anyhow, as bees build their combs. They

know what the final result is to be, and all work towards that without finishing individual parts as they go along.

The variegated appearance of many nests is doubtless due to the fact that different wasps bring in materials of different colours and apply them indiscriminately.

Dr. Ormerod is of the opinion that only young wasps build, and this seems probable, as the secretion necessary to form the paper would be most abundant in young insects, just as with bees the younger ones perform the office of nurses, and supply the food partly digested by themselves to the larvæ.

Young wasps are larger than old ones, and their wings are not tattered, and it was such only that Dr. Ormerod saw at work on the nest.

The old wasps find work enough in providing insects for the many hungry larvæ.

A flourishing wasp's-nest is a scene of constant building up and tearing down.

No sooner is the outer covering completed than the combs have to be enlarged and new tiers of them added.

This enlarging is done by gnawing away the walls from the inside, and adding layers on the outside. Thus the space within is increased without exposing the combs.

There is never any connection between the walls of the cells and the combs.

The combs are suspended from supports above, and hang free in the space formed by the enclosing walls.

When a comb has reached a certain size the wasps do not continue to enlarge it, but suspend another comb below it, fastening the new structure to the old by a stout paper-pillar support in the centre, and this is often reinforced by a number of side supports.

The wasps use the roof of the new comb as a floor to the space above, and indeed a wasp's-nest is but a series of floors, or stages, suspended one below an-

other, each floor having attached to its under side a large number of cells opening mouth down.

The same cells are generally used two or three times, for as soon as one brood is hatched the cells are cleaned and put in repair by the workers and more eggs are laid in them by the queen.

The first cells built are smaller than those in the later combs. As the colony prospers, it becomes generous in its treatment of the new members. The cells built by the many industrious workers are larger, and their well-fed occupants are also larger; indeed towards the end of the season there sometimes come forth large and portly workers that approximate the queen in size.

WORKERS, QUEENS, AND DRONES

THE interior of a wasp's-nest is a very marvel for neatness and order. It is kept perfectly clean, and probably the wasps ventilate it through the hole in the bottom which in some nests forms the only entrance, as bees ventilate the hive by fanning with their wings near the opening.

Certainly, captive wasps fan, just as captive bees do, and it is reasonable to suppose that this action is applied as a remedy for bad air.

The wasps, like the bees, have sentinels to watch at the entrance, and when a nest is disturbed these are the first to fly out and investigate the cause of the disturbance.

At their alarm the inmates of the nest rush forth, an angry swarm, ready to sting anything or anybody within reach.

Hornets have been known to work by moonlight, and captive wasps are unable to compose themselves to sleep if there is a light near them.

The workers do all the work of the hive, and live on friendly terms with one another and with the world in general, unless some one from the outside world alarms them and causes them to fear harm to their nest.

Wasps do not steal from one another as bees so often do, and different swarms do not fight, though once in a while there will arise bad blood between two members of a nest; then there will be a fierce combat very likely resulting in the death of one.

Generally, however, the wasps are friendly with one another, and when a worker flies home with her stomach full of honey she is willing to regurgitate the delicacy for the benefit of her relatives. She stands and puts forth a glistening

drop from her mouth while two or three hungry sisters eagerly lap it up.

Although the wasp's-nest has such a modest beginning it often attains quite lordly dimensions toward the end of the season, and contains many thousands of inhabitants.

For several weeks only workers are developed. Then into some of the larger cells, which, we have seen, are built later, unfertilised eggs are laid, the queen having the power to fertilise the eggs or not, as she pleases. From these unfertilised eggs drones are developed. Sometimes the drone combs are quite distinct from the worker combs, the cells in those being larger than the worker cells; and again, drone eggs are laid in the larger cells of the worker combs.

The drone is the male wasp. He is usually larger than a worker, is more brightly coloured, has long, drooping antennæ, and he has no sting.

He is rather sluggish as compared with the workers, and likes to put his head down into an empty cell and stay there with only his tail visible — probably taking a nap.

Sometimes, however, he bestirs himself and helps to feed the larvæ, going from cell to cell and popping food into each wide-open mouth.

At least, yellow-jacket drones have been seen to do this in captivity.

It is said the drone also keeps the vespiary clean, clearing away all rubbish and carrying out dead bodies.

The workers are undeveloped females that hatch from fertilised eggs. Usually they have not the power to lay eggs, though if the queen disappears some of the better developed of the workers sometimes lay eggs. These are never fertilised, and consequently produce nothing but drones.

Soon after the drone eggs are laid, the

workers build yet larger cells than any yet constructed, and in each of these a fertilised egg is put. When it hatches, the careful nurses supply it with abundant food.

In its larger cell, with room to develop and plenty of nutriment, the insect becomes a perfect female, or queen.

The queen cells are not only larger than the others, but are also taller, the cap being built down farther below the edge of the cell.

The queen combs are very pretty with their snowy, rounded domes.

Often they are the last made, and therefore are the lowest combs in the nest.

Frequently the lowest comb will be wholly devoted to queen cells, though sometimes they are found encircling other combs.

In time the queens emerge large and handsome.

They are bright in colour, and are marked differently from the other members of the

nest. They are considerably larger than the drones, and can be recognised at a glance.

On sunny days they fly abroad, where they mate with the drone. Each queen at that time receives a quantity of fertilising material, which she stores in a receptacle that exists for that purpose, and this material she uses at will to fertilise her eggs. The queens mate but once, the supply they receive lasting as long as they live. Queens and drones spin their own cocoons just as the workers do. Indeed, the development of the queens and drones from egg to pupa, and from pupa to perfect insect or imago, is essentially the same as the development of the workers.

Several sizes of wasps may always be found in the same nest. Not only are the queens larger than the drones, and the drones larger than the workers, but queens,

drones, and workers differ in size among themselves.

Some queens will be very large and beautiful, others will be much smaller.

Drones differ in size even more than queens, some being large and well-developed, others being scarcely larger than workers.

Sometimes tiny little workers are seen in a nest, not more than half as large as the largest of their kind.

Very likely the food given causes this difference in size. Some larvæ occupy larger cells and better positions in the combs than others, and probably receive more attention from the nurses.

The larvæ that get the most food develop into the largest and finest wasps.

Although the wasps' nests are so wonderfully constructed, they are not fitted to serve as winter habitations.

It is not necessary that they should be so used, for the history of a wasp colony

is very different from that of a swarm of bees.

The worker bees remain alive through the winter, and the same hive is densely populated year after year.

Not so with the wasps. At the approach of cold weather they desert their nests.

No more combs are built, and even the eggs and larvæ already in the cells are abandoned.

Winter is coming, and with the first severe cold all drones and workers must perish.

Meantime, all thought of work and of home forgotten, the wasps fly about, often in large numbers, visiting the fall flowers, eating the ripe fruit, getting into houses, making nuisances of themselves, and having a good time generally.

The French naturalist Réaumur says that the wasps not only abandon their larvæ at approach of cold weather, but that they drag them out and ruthlessly kill them.

This does not seem to be true of American wasps. They are content to leave their helpless young to the mercy of the frost, which is perhaps less merciful than the apparently cruel massacre of Réaumur's wasps.

The young queens having power to resist the cold, crawl into some cranny, where they lie apparently lifeless, with their legs and wings folded about them, and await the coming of spring. Even in this state they can sting, as more than one luckless experimenter has learned to his cost.

Some people are afraid to take a wasp's nest into the house in the fall of the year, believing it to be full of dormant wasps that only need the genial warmth of the house to come to life and rush forth intent on making it lively for their entertainers. But this is not the case. The fall nest can be safely handled, as it is empty of living wasps.

Very soon the interior of a nest abandoned by the great mass of inhabitants becomes unfit for the habitation of the hibernating queens.

It becomes damp and mouldy inside, and is taken possession of by all sorts of vermin. Moreover, the fierce winter blasts blow these delicate fabrics to pieces, so that it is usually impossible to find a last year's wasp-nest, no matter how plentiful the nests may have been.

On rare occasions a nest in a very sheltered dry spot may escape destruction, and it is possible that queens may occasionally winter in these nests, though such an occurrence is a rare exception, if it ever happens.

Although it is within comparatively recent times that the habits of the social wasps have been scientifically studied, yet the ancients were not unobservant of these interesting insects.

Indeed, Aristotle, in his "History of Animals," has given a very admirable account

of the nests and the habits of the wasps. He describes their hexagonal cells, which he compared to those of bees, adding that they are not formed of wax, but of a web-like membrane, made of the bark of trees. He also describes the young in the cells, and tells us that in his time the wasps were so harmful to the bees that the bee fanciers caught them in pans in which they had placed pieces of meat. When many had collected in the pan it was covered and set on the fire.

Wasps are still fond of bees and when able will catch them and carry them as food to their nests. They are very fond of honey, so no wonder the honey-laden bee should be a tempting morsel, combining as it does both honey and juicy insect food.

Aristotle accurately describes the queen wasps and the workers. He also gives a clear and accurate account of nest-making, the rearing of workers first, and later of

the mother wasps, and he describes the abandonment of the nest at the approach of winter, telling us that only the mothers survive to start the nest anew next year.

Indeed, he gives so good and so accurate an account of the whole history of the wasps, that modern writers have added but little new information.

WASP ARCHITECTURE

WASPS cling to the traditions of their ancestors in nest-building. Each species has its own inherited ideas on the subject, and invariably builds in accordance with those ideas. But while the nests differ in certain fixed details, in a broad general way they are all alike. All are made of paper. All contain combs enclosed by separate outer walls.

The hornets build smooth and handsome structures of paper that can be peeled off in large sheets and they generally have but one entrance hole near the bottom. Some of the yellow-jackets make nests of coarse, friable materials, that break at the slightest touch. Sometimes sand is found in the paper of which wasps' nests are built, and some yellow-jackets lay on their walls, not in large separate

sheets, but in the form of shell-work, or overlapping scales. Such nests generally have several entrance holes and are often very handsome structures.

As a rule the nests built by yellow-jackets in the ground have coverings of coarser material and less elegant architecture than nests built in trees or under roofs. But even where the nest is in the ground, it has its covering of paper walls. Certain species of yellow-jackets, or ground-wasps, as they are often called, take possession of a hole they find, and this they enlarge to suit their needs by biting off and carrying out, bit by bit, the earth. They are cave-dwellers, but their caves are made warm and comfortable by the paper lining they always give them. It is quite a surprise to dig out one of these nests for the first time and find the snug and complete habitation, often of quite large size, and fitted up with its tiers of combs and all the essential parts of an out-door nest.

All wasps' nests are able to resist moisture to quite an astonishing degree, because of the glue-like saliva with which the building materials are welded together and with which the nest is sometimes varnished over.

The strength of paper depends largely upon the length of the fibres of which it is made, and Vespa, using very friable materials, makes them as serviceable as possible by gnawing the wood lengthwise of the grain, instead of cutting it up into sawdust. Thus she is able to convert wood into a paper that holds together as long as she needs it.

In late years the wasp's secret of making paper from wood-pulp has been discovered by man, and truth to tell, the product he supplies is sometimes little better than wasp paper in strength or appearance. Some consider the wasp paper far the prettier.

Since Vespa builds her habitation of paper which she herself manufactures, and

since she is a creature of resources, she is willing to use any good paper-making material that comes her way.

She, no doubt, prefers the wood fibre or the fibre obtained from leaves or roots used by her ancestors for countless generations, yet if that is not convenient she does not hesitate to take any reasonable substitute. She has been known to make a gay abode of bright colours from unknown materials. The author of "Homes without Hands," says, —

"I have seen a nest which was made almost entirely of the blue and white paper used for cartridges, the wasps having taken advantage of the expended papers, and used them instead of taking the trouble to gnaw hard wood."

Vespa does not use ready-made paper, but chews it up and re-spreads it, so to speak, into wasp paper.

The present writer once took a yellow-jacket's nest in which the predominating

colours were dull red and yellow, and the outer wall was laid on in a fine and very elegant shell pattern. The paper of this nest was so very brittle that it fell to pieces at the slightest touch, and the nest itself was built to fit in an irregular space in a cornice at the corner of a piazza. There were half a dozen or more entrance holes scattered over the walls of the nest, a common thing in this form of architecture.

Generally wasp paper is grey in colour, for generally it is made of weather-worn wood. Usually the grey is in bands of alternating light and dark, and often these bands are in waving lines, which gives a pretty effect to the whole.

Favourite building-sites for hornets and the tree-dwelling yellow-jackets, are wooded mountain sides. The wasps enjoy the seclusion of the woods, and are apt to be a little inhospitable — some might go so far as to say resentful — when the children of

men wish also to enjoy the mountain slopes, as most climbers have had reason to know. The hornets, no doubt, cannot comprehend a mental condition which sends creatures wandering about strange forests for the mere pleasure of wandering, and when they see the terrifying biped approach and intrude upon what they consider their territory, wild with fear and rage they sally forth, and without word of warning smite the happy and unsuspecting pilgrim into a temporary indifference to the beauties of nature.

They like also to build in swampy places, but they are not very conservative on the subject of building-sites, and often choose to hang their nests in a snug corner under the rafters of a barn or the eaves of a building.

In hot countries the social wasps are more abundant than in temperate climates, and all sorts of queer-looking nests may be met with in the forests and jungles of the

tropics. There are a good many species scattered over the world that are not represented in North America at all. Some build enormous nests with a hard, crust-like covering ornamented with many projections which cause them to look like monstrous fruits with rough rinds. But woe to the ignorant traveller who seeks to possess himself of this strange tropical fruit!

A South American species builds a bag-like nest several feet long and crowded with tens of thousands of cells, the whole encased in a hard rind-like covering.

Wasps seem to make their nests according to the circumstances of their lives. In India, where the dry season lasts the lifetime of the wasps, one large species of *Vespa* builds its nest of mud. When the rains come the queens hide away, ready to start a new nest at the beginning of the next dry season.

In Demerara, where the storms are violent, the nests are often covered with a hard case, one species making a beautiful white, polished cardboard-nest, so strong and compact that it can withstand the hardest rainstorm. This nest is usually broadest at the top, and is entered by a hole in the bottom.

The combs are very regular in form, and very prettily placed within their protecting walls.

It is said the mocking-birds build their nests above those of the card-board wasps to secure their young from the attacks of monkeys.

Monkeys are fond of young birds, but seldom would one be hardy enough to try for a meal by climbing over a wasp's nest!

The mocking birds are not the only ones wise enough to make the wasps their garrison of defence, for there is a little fly-

catcher in South America that makes its home close to the nest of one of the social wasps.

There is a South American wasp that builds its combs in concentric spheres, instead of in horizontal layers, and this thickly packed interior is surrounded and protected by a very thin wall.

Another social wasp builds its comb along the trunk of a tree, covering it over with an outer shell.

A pretty little nest is found in South America attached to the under side of a large, strong leaf. It consists of one flat comb of tiny cells covered over by a hard shell or wall.

Indeed there seems to be no end to the variety in form, size and material of the nests of the social wasps in different parts of the world, and the traveller in tropical countries will do well to remem-

ber never to interfere with a queer-looking object hanging on a tree — or anywhere else for that matter.

It is wiser to let it alone and find out what it is by asking.

TAKING NESTS

WHOEVER aspires to owning a family of tame hornets should begin operations early in the season, when the little ball-like nest can be easily and safely taken after nightfall, with the queen at home. The wasps will not desert the nest so long as the queen is not lost. If not frightened or hurt they soon make friends with their captor.

As few people, however, will have the opportunity, or inclination, to capture a nest of live wasps and manipulate it so as to see what is going on inside, a better way to satisfy one's craving for a knowledge of wasps, is to wait until about the middle of September, then, having found a yellow-jacket's nest in a convenient location (on the eaves of a building is

good), wait until some cool evening when the wasps are sluggish.

With a long-handled hoe or other implement suddenly pull the nest down — and run!

Get around a corner of the building out of sight and wait a few minutes.

The wasps will at once cluster on the old site of the nest, not following it to the ground.

When the excitement is over, in five minutes or so, go quietly back, moving slowly and gently, pick up the combs that are scattered on the ground, taking as many wasps as possible on them. Lay the combs in a cardboard box over which place a cover of wire-netting.

Combs can thus be taken without covering the face and hands and without getting stung, though a few stings rightly regarded only add to the zest of the adventure, as a yellow jacket's sting is not a very serious matter, anyway.

Through the netting all the operations of the workers can be watched.

The combs should be laid in upside down, which may be a little disconcerting to the occupants but which keeps the mouths of the cells from resting on the floor of the box and also enables the observer to watch the process of feeding the larvæ.

A little hanging door should have been cut in one end of the box so that food can be put in.

By the middle of September the combs will contain capped cells of workers, drones, and queens, as well as open cells that contain larvæ in all stages, and unhatched eggs.

There should be at least a few workers in with the combs to care for the larvæ until more workers hatch out.

Soon there will be a large and ever-increasing family. Workers will uncap their cells and come out, then drones will

begin to appear, and finally the large and handsome queens will come forth, and all will industriously feed the remaining larvæ.

Honey or syrup should be supplied as food to the adult wasps, and flies or raw meat should be given them to feed the larvæ.

They feed the larvæ some syrup or honey, but like to add animal food to the diet.

A wasp will bite out a bit of raw meat and put it into the mouth of a larva, leaving the infant to chew it up as well as it can.

It is an amusing spectacle to see a combful of larvæ each with a bit of red meat in its mouth, upon which it is industriously feeding.

The combs can be successfully watched for several days, the length of time depending upon the environment, for the young brood exposed to changes of temperature eventually perish before all have

completed their transformations. The box should be covered at night and at all times kept away from cold draughts.

A large number of queens, drones, and workers under ordinary circumstances will hatch out under the eye of the observer, and some of the larvæ will be sure to spin their cocoons.

When one understands wasps and their habits, the common fear of these creatures very largely departs.

It is not difficult to get possession of the combs in a yellow-jacket's nest, and even the stings of these creatures are not so fearful as fancy paints them.

With care one need not get stung. It is astonishing how many liberties one can take with yellow-jackets, if one has knowledge of their ways and exercises self control and intelligence when dealing with them.

Not long since a yellow-jacket's nest was raked down from the eaves of a house, and

the operator succeeded in getting several of the combs, with a number of wasps on them.

The combs with pieces of the paper walls were put in a cardboard box and covered with mosquito netting, but this had to be replaced at once by wire netting, as the little captives gnawed their way out the second day of their captivity. Fortunately they were discovered just in time, the box was covered with wire gauze, and the refugees were caught and returned to it.

There were three sizes of cells taken. One comb was composed entirely of small worker-cells, one of drone-cells and one of queen-cells. Several broken combs contained worker-cells only, and in this particular nest each comb contained but one kind of cell. The queen-cells were all capped, and so were most of the drone-cells, but in the worker-comb were larvæ of all ages, as well as newly laid eggs.

The workers put in the box with the combs took care of the larvæ, and as the combs lay with the mouths of the cells up, the little creatures must have been greatly puzzled by this upside down state of affairs.

The larvæ were no longer hanging head down but their mouths were still open begging for food, and a lively time the few workers captured with the combs had, caring for this numerous and ravenous family. Soon, however, strong little jaws began

to gnaw the caps from the cells, then little heads began to appear and new wasps came forth. These new wasps washed their hands and cleaned their antennæ, and at once began to feed the still uncapped larvæ, that is, after they had satisfied their own hunger.

The wasps did not try to build up the nest again, but devoted themselves to the larvæ and to efforts to escape. It was very

interesting to watch them feed the infants, and feed the drones when those large and lazy fellows began to come out of their cells.

One morning a hole was noticed in a queen cell, and a pair of jaws were at work inside enlarging it. The observer was too impatient to await the slow process of my lady's natural emergence, and with a long hat-pin gently assisted her in tearing off the cap. Then forth stepped the handsome young queen, the first of the season.

The workers near her cell greeted her appearance with some show of interest, running to her, caressing her with their antennæ, and feeding her from their mouths, though they had paid no attention to the coming forth of drones or workers.

The queen differs from the workers in her fuller development. She doubtless is the product of abundant nutriment.

We know the queen bee is produced by special feeding and no doubt it is the same with the wasps. The queen wasps differ in size, though not as much as the drones.

After the first queen had come forth others followed in quick succession and the box was soon buzzing with a large number of queens, drones, and workers.

Taking a wasp's nest in the fall of the year is not as unkind as it may appear, since the workers and drones must soon perish anyway, and even the last of the eggs and larvæ in the course of nature fail to mature, and perish from cold in their cells. When the wasps have been watched for a few days and one's curiosity is satisfied, the kindly naturalist will allow the captives their freedom, thus preserving the queens to start new nests the next year. The queens cannot mate in captivity, this function being performed on the wing, and they will not live the natural span of their

lives unless freed soon after coming from their cradle cells.

Under ordinary circumstances wasps should not be destroyed, as they are our good friends, keeping down the hordes of insects injurious to vegetation.

ENEMIES

WASPS, like other folk, have their enemies.

Certain birds catch and eat them, and certain badgers, it is said, feed upon their nests.

One would not expect them to fall victims to such a foe as the ant, yet such is the case in tropical countries.

Mr. Belt, in his "Naturalist in Nicaragua," tells this remarkable story, —

"The ants send off exploring parties up the trees, which hunt for nests of wasps, bees, and probably birds. If they find any they soon communicate the intelligence to the army below, and a column is sent up immediately to take possession of the prize. I have seen them pulling out the larvæ and pupæ from the cells of a large wasp's nest, whilst the wasps hovered

about, powerless, before the multitude of invaders, to render any protection to their young."

The worst enemies of the wasps are to be found within their own nests, from parasites of their own Order.

Certain little chrysis flies are bred in the nests at the expense of the wasps.

The bold mother chrysis enters the nest, deposits her own egg in the cell with a wasp larva, and when the chrysis hatches it proceeds to suck the juices of its host. As the chrysis lives and commits its depredations at the bottom of the cell, below the wasp larva, it is not discovered.

Perhaps the nurse wasps wonder why some of their little charges are so sickly, but there is reason enough, for their life juices are being drained, and when they have finally spun their cocoons they are wholly at the mercy of the enemy and dwindle to a small shrunken mass, while the young chrysis, fat and hearty, finally

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makes its own cocoon beneath the defrauded wasp larva, first forming a sort of roof over its end of the cell. This roof is light brown in colour and looks not unlike the scale of a pine-cone seed.

If the roof is carefully broken away, the young usurper will be discovered wrapped in a glistening silvery blanket, a royal covering compared to the simple silken covering of the young *Vespa*.

There is nothing in its line, prettier than the little tinsel cocoon one can pull out of the raided cell, and within which lies the infant chrysis. It is a little savage wrapped in robes of savage splendour.

Its transformations completed, young chrysis finds its way out through its own roof and through the tough cocoon built by the despoiled larva, a small impertinent-looking black fly with long sensitive antennæ.

There are several other parasites, vegetable as well as animal, that infest the

Vespæ; so, in spite of her formidable weapon, Madam the Wasp cannot free herself from all enemies. The toad is said to find the wasp an agreeable article of diet, and to swallow the piquant delicacy with relish. This finished *gourmet* has been seen sitting close to a wasp's nest and snapping up the delicious morsels as they drew near, winking his eyes in evident enjoyment of the fiery repast.

Boys are the natural foes of the wasps, destroying their nests for the mere fun of it, but the Creoles of Mauritius take the nest for the sake of the larvæ, which they roast in the combs and eat.

The nests are taken by burning out the wasps, and the combs are sold at the bazaar of Port Louis.

Destroying wasps' nests by burning is a common practice to-day, as it was at the time of Euripides, who thus refers to it in his drama "The Cyclops": —

Chorus of Satyrs (to Ulysses, who tells them they must help him to put out the Cyclop's eye with an enormous burning-brand). "How lightly would I lift the load of e'en a hundred wains, if that will help us grub out the eye of the doomed Cyclops, like a wasp's nest."

INTELLIGENCE OF WASPS

WASPS possess an intellect that is an honour to them, in-so-much-as it is doubtless a development resulting from their own efforts to accomplish results they were capable of conceiving and of desiring to accomplish.

They know a great deal as a result of what might be called ancestral memory, a memory of deeds their ancestors performed so often that in time such deeds became perfect and automatic; and this memory we are accustomed to entitle instinct.

The mind of the wasp still remains active, the insect not wholly relying upon its ancestral memory for present emergencies. It can still observe, remember, and reason.

Wasps reason well, but they do not argue at all, though where humankind is

concerned, they have remarkably effective powers of persuasion. They say to a man, "Go," and he goeth forthwith.

They are very quick and alert in their movements and have a pretty way of turning their heads to look at one who has made friends with them, so that they are not frightened at his approach.

Wasps, like bees, learn to know individuals, and they have their likes and dislikes, allowing some persons to approach their nest unmolested, and stinging others.

There was once a nest of little yellow-jackets in a wood-shed, where whoever entered was obliged to pass within a few inches of it. This most people could do with impunity. But there was a coloured boy whom the black-and-yellow tenants of the nest could not endure. They would not allow him to enter the shed, or even to come within several yards of the door. "They bite me whenever I go that way," he complained, and he had not molested

them in any way. Perhaps he smelled of deceit, and they were afraid to trust him near their precious paper fabric. Romanes tells of a man who used the wasps to police his premises. This clever person allowed a species of wasp native to Natal to build in the door-posts of his house, and although he often interfered with their nests, he was stung but once, and then by a young wasp. The value of this arrangement is better appreciated when one learns that the wasps allowed no Caffre to approach the door, much less to pass through.

It is generally easy to make friends with the wasps if the nest is near at hand, and if they are never frightened or tormented. They do not sting for the sake of stinging, but only in self-defence. There are a number of cases on record of people having allowed the hornets to build in their houses, and suffering no inconvenience in consequence.

That wasps have a good memory was shown by those that learned to go to their nests through a paper opening of various colours. They not only observed the colours but remembered them.

Once a wasp's nest was built in an attic, and the wasps were in the habit of approaching it through an open window. One day this window was closed, and after bumping against the glass a few times, the wasps found another entrance, and did not again attempt to pass through the window.

Wasps show a good deal of ingenuity in accomplishing their ends. A wasp, having caught a large fly, whose wings, being blown by the wind, impeded its progress, was seen to stop and cut off the useless and troublesome members. It is quite common to see wasps cut an insect in two when it is too large to be carried whole.

More remarkable than this, however, is the device sometimes used by hornets that

have caught too heavy a prize. Instead of cutting up the insect, the hornet drags it to the foot of a tree, drags it up the trunk to a branch, from which vantage point it is able to fly with its burden.

Although wasps are very fond of flies, they catch many kinds of insects, and, it would seem, even larger game. There are on record two hunts that outdo all other feats in wasp annals.

Edward Topsell, who wrote the quaint "History of Four-footed Beasts and Serpents," says, —

"Whilst Pennius was at Peterborough in England, he saw in the wide and open street a Hornet pursuing a Sparrow, whom when he wounded with his sting, he fell down dead to the ground, and with the admiration of all that beheld them, he suck't out and filled himself with the blood of the slain prey."

Again Topsell claims to have seen the same thing.

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“I myself, being at Duckworth in Huntingdonshire, my native soyl, I saw on a time, a great Wasp or Hornet making after, and fiercely pursuing a Sparrow in the open street of the town.” — The end was tragic, as before, the wasp conquering, and sucking the blood of the luckless bird.

Mr. Belt tells a very interesting story of the ingenuity of some social wasps he saw trying to keep the ants away from honey they themselves wanted.

These ants were attending clusters of frog-hoppers, little insects that exuded a sweet liquid much relished by both ants and wasps, and for the possession of which a constant skirmishing was going on.

“The wasps stroked the young hoppers, and sipped up the honey when it was exuded, just like the ants. When an ant came up to a cluster of leaf-hoppers attended by a wasp, the latter would not attempt to grapple with its rival on the leaf, but would fly off and hover over the

ant; then when the little foe was well exposed, it would dart at it and strike it to the ground.

“The action was so quick that I could not determine whether it struck with its fore-feet or its jaws, but I think it was with the feet. I often saw a wasp trying to clear a leaf from ants that were already in full possession of a cluster of leaf-hoppers. It would sometimes have to strike three or four times at an ant before it made it quit its hold and fall. At other times one ant after another would be struck off with great celerity and ease, and I fancied that some wasps were much cleverer than others.

“In those cases where it succeeded in clearing a leaf, it was never left long in peace.

“Fresh relays of ants were continually arriving, and generally tired the wasp out. It would never wait for an ant to get near it, doubtless knowing well that if its little rival once fastened on its leg, it

would be a difficult matter to get rid of it again.

“If a wasp first obtained possession it was able to keep it, for the first ants that came up were only pioneers, and by knocking these off it prevented them from returning and scenting the trail to communicate the intelligence to others.”

Wasps, as we already know, form their habits according to their environment. Those living near human habitations are more friendly than those living in the wilderness, and they learn to eat the food of man.

It seems the wasps even learn to sting according to circumstances. Our wasps fly directly at the bare face or hands if they have any pointed remarks to make.

Mr. Belt says of the wasps of Nicaragua, —

“I got severely stung by a number of small wasps, whose nest I had disturbed in passing under some bushes. About

thirty were upon me, but I got off with about half a dozen stings, as I managed to kill the rest as they made their way through the hair of my head and beard; for these wasps, having generally to do with animals covered with hair, do not fly at the open face, but at the hair of the head, and push down through it to the skin before they sting. On this and on another occasion on which I was attacked by them, I had not a single sting on the exposed portion of my face, although my hands were stung in killing them in my hair. It is curious to note that the large black wasp that makes its nest under the verandas of houses and eaves of huts, and has had to deal with man as his principal foe, flies directly at the face when molested."

USES OF WASPS AND NESTS

TO most people the wasp, like the fly and the grasshopper, is a nuisance, a mere pest that the world would well be rid of. Yet the world could not afford to lose its wasps.

They have their place to fill in the scheme of nature; and how do we know but that the sudden extermination of the wasp kind might unbalance the whole solar system and disorganise the universe generally?

Certainly the wasp occupies its place in the world with a confidence that justifies the assumption that it has a right to exist, and is even necessary to the maintenance of terrestrial order.

Nor has man disdained to use it and its nest, though, truth to tell, the principal use made of it in olden time was to cure

its own stings; and there may be those small-minded enough to argue that if there were no wasps, their stings would not need to be endured or cured.

It was, and in some places still is, a common belief that wasps can be made to cure their own stings by being bruised and applied to the wound.

Another cure for stings consists of wasps' combs made into a plaster with willow leaves and mallows.

Also, the earth wherein wasps' nests were built, if mixed with vinegar and applied, was once believed to effect a cure.

Since wasps, if misunderstood, insist upon punctuating their position with more fervour than manners, it is but fair that they should be made to cure the wounds they inflict. However, there is reasonable cause to doubt the efficacy of wasps' nests and vinegar, or of crushed wasps themselves.

But though modern scepticism may have overthrown the poetic justice done the wasps by our predecessors, it is good to remember that once the oil of wasps was recommended by a surgical writer in the seventeenth century as being a cure for their stings; and that another recommended a poultice made of wasps.

A cynical modern writer, who may have good cause to know, says he has "heard of cures, but never experienced one."

That the sting of the wasp is effective internally as well as externally, is attested by the following sad statement, —

"Allen's wife drank a wasp and fell down and dyed."

The chronicle does not say whether the lamented Allen's wife drank it on purpose or accidentally.

The worst known case of a malady caused by wasps is that of the Emperor Vespasian, who had a wasp's nest in his nose.

“It was an awful sight,” says the chronicle, and one would think it might be!

Saint Veronica, who had been healed by touching the hem of Christ’s garment, fortunately for the afflicted emperor, possessed a miraculous cloth, on which was imprinted a perfect likeness of Christ’s face. This cloth she took to Rome and held up before the face of the unfortunate emperor, who believed, and was straightway cured.

Wasps have been used for other purposes than to cure their own stings, and they have been known — or believed — to bestow good, instead of ill, upon mankind; for the ancients, we are told, attribute “great vertue to the distilled water, and likewise to the decoction of common wasps.”

Also, the large sheets of paper that envelop hornets’ nests are used for polishing spectacles in some country places, and the nests themselves are burned and in-

haled as a cure for asthma or colds. They are also burned near horses that are troubled with colds or with distemper, and are given to them in their feed "to cure thick-windedness."

Moffett, moreover, has a friendly word for the wasps, and informs us that "their use is great and singular, for besides that they serve for food to those kind of Hawks which are called Kaistrels or Fleingals, Martinets, Swallows, Owls, to Brocks or Badgers and to the Cameleon: they also do great pleasure and service to men sundry ways, for they kill the Phalangium, which is a kind of venomous spider, that hath in all his legs three knots or joynts, whose poyson is perilous and deadly, and yet Wasps do cure their wounds."

A pair of Carolina wrens in the Blue Ridge mountains once selected a large wasp's nest hanging in the entry of a house in which to take up their winter quarters.

They slept in it every night for several months.

The wasps have ever been used to “point a moral and adorn a tale,” and that they did not escape as illustrations of moral lessons for man’s betterment, Mr. Moffett thus assures us:—

“Clemens Alexandrinus, when he would express and declare the foulness and abominable hurt of such sins that do lie in wait, as it were, to deceive, and watch to do displeasure to the life of man, hath these words, —

““That is, these fat, dull, grosse and Olympick enemies of ours are worser than Wasps, more cruel and displeasing, and especially sensuall and worldly pleasure.’”

SUPERSTITIONS ABOUT WASPS

WASPS were augurs of evil in ancient days, and we are told that in the year 190 B.C., "an infinite number of wasps flew into the market at Capua, and sat in the temple of Mars. They were with great diligence taken and burnt solemnly. Yet they did foreshadow the coming of the enemy and the burning of the city."

Wasps were also looked upon as weather prophets, and probably are still as reliable as ever they were in that capacity.

If hornets build high it is a sign the winter will be dry and mild; if low, the winter will be cold and stormy. Hence the following popular rhyme, —

" If hornets build low,
    Winter storms and snow ;
If hornets build high,
    Winter mild and dry."

This old superstition was probably founded upon the belief that hornets remain in their nests during the winter, in which case they would be safer to build low when a hard season was at hand.

Probably a truer prediction is that made by an observant gamekeeper who said that the height at which wasps make their nests above the water is a rough index of the amount of rain expected during the summer. In a wet season they choose the top of the bank near a brook, in dry they may build almost at the water's level.

It was once believed that hornets flying late in autumn foretold storms at sea.

This seems a less reasonable prediction than the one where it is said, if wasps are seen flying about in great numbers toward evening, it is a sign that the next day will be fair and hot; but if they enter their nests often at twilight, as if to hide or

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shelter themselves, that is a sign of stormy weather.

For wasps, hornets, and gnats to bite more eagerly than usual is a sign of rainy weather.

There is a superstition in England, and also in some parts of America, that the first wasp seen in the season should be killed, thereby insuring good luck and freedom from enemies throughout the year.

Opposed to this is the belief that the first wasp seen should not be killed, and many people consider it bad luck ever to kill a wasp.

If a wasp stings you, it is a sign your foes will get the best of you.

If the first wasp of the season is seen in your house, that is a sign you are to form an unpleasant acquaintance, while if the first bee is seen in your house, you are to form a pleasant acquaintance.

If wasps build in a house, it is a sign the occupants of that house are coming to want.

POLISTES

POLISTES is a charming little social wasp, with the paper-building instinct on one hand, and the general appearance of the solitary wasp on the other.

Her pretty paper combs are hidden away in bushes, or hung up in out-buildings, and they are never covered with a protecting outer wall. She has no fear of fresh air, and her offspring grow up blown about by every breeze that passes their dainty cradle cells. Her nest is small compared with that of *Vespa*, and her family are few in numbers.

In form she is long and slender, and in colour she is brown with reddish spots on the big end of her abdomen, and sometimes with one or more yellow rings about her body.

She has a little flat tongue, like *Vespa*, and seeks nectar upon the flowers that *Vespa* visits. Only the females live through the winter, each one starting her own nest in the spring. She begins with a little group of three cells, like *Vespa*, and her comb grows in diameter until it may become as large as the palm of one's hand. Sometimes when a particularly fine place is discovered, a number of wasps occupy it, building their combs so close together that they look like one broad sheet.

Once these wasps completely lined with their combs the shelter that covered the skylight window of an artist's studio.

If they had done it with the deliberate intention of displaying themselves, they could not have chosen a better position.

One standing below could look up through the window-glass directly into the open mouths of the cells, as the nests hung suspended from the shutter, and

thus all that was going on could be safely observed.

Polistes is very careful about strengthening the little stalk that supports her nest. Vespa usually attaches her structure by the broad roof of the outer covering, or if it hangs in a tree, builds it about one or more branches so that it is very firmly fastened, but Polistes has only the slender support, or pedicel, in the centre or at one end of hers, to hold it in place, and this little paper stalk she licks again and again, laying on thick layers of sticky, glue-like saliva until it shines as though it had been varnished.

It is easy to take the nest of Polistes, as she makes very little resistance.

Indeed, one can cut the nest down and carry it off, wasps and all, with very little danger of getting stung.

Once a nest about two inches in diameter, was taken with half a dozen wasps on it. Some of the cells were occupied by

larvæ in different stages, while others were capped over, and still others contained eggs.

It was necessary to keep the nest shut up in a box for several days, and in that time the confined wasps, perhaps becoming crazed by adversity, so far forgot themselves as to pull the larvæ out of the cells and suck their juices.

Wishing to save some, if possible, the captor removed the unnatural nurses, and undertook the delicate task of feeding the larval infants herself.

Holding up the little nest by its stem to investigate the state of affairs, she discovered four full-grown, but still hungry larvæ, with protruding heads and wide-open mouths.

Their foster-nurse offered one a drop of maple syrup on the end of a wooden toothpick, and to her delight the larval infant greedily sucked it up.

One by one the appetites of the four were finally satisfied—though it seemed

for a time as though their guardian's whole life must needs be devoted to these ravenous foundlings.

For three weeks they were fed several times a day alternately on maple syrup and raw egg, and it began to seem as though they had given up all intention of proceeding with their natural lives, and had resigned themselves to an indefinite orgy of maple syrup and egg. Did ever wasp larvæ remain larvæ so long? They must have gone at least two weeks over their time before they began to show signs of spinning.

Then, one day, when their rations were proffered them, fine, sticky threads adhered to the toothpick, and their weary but patient nurse joyfully realised that at last they were going to "take a rest," and give her one too.

Nor were her hopes vain. One spun a thin, delicate, almost transparent cocoon, and unkindly did it in the night, when

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it could not be observed. By morning the ungrateful larva had retired from view.

The next, however, rewarded its nurse's patient care by beginning operations in the middle of the afternoon under her very eyes, and as she watched the dainty weaver she felt fully repaid for three weeks' unremitting administration of syrup and egg in toothpick portions.

First the larva lined its cell, turning its head down under its body, and also turning around and around in the cell.

Then it began to build the cell walls higher, for the wasps, in anger or despair or for some other reason, had chewed down the edges of its cell before they were removed, so that it was not long enough to contain a full-grown wasp.

The hand fed larva knew this, and so it laboriously spun a top story to its room, and then built over its head the prettiest rounded dome of snow-white silk.

Its silken covering was not so thick as that of the wasps reared on the natural food of wasps, but it was very perfect as far as it went, and so thin that the larva could easily be seen through it.

The larva remained its own white, grub-like self for several days, and then—one day the nest was examined, and there shone through the thin cocoon the face of a wasp!

The hand-fed larva had actually transformed. Weeks passed and it did not come forth. Finally the cell was opened, and it was found—dead, with its wings not formed. It had done its best, but too much turning up the wrong way,—for the nest had to be inverted to feed the larvæ,—or more probably an innutritious diet, had defeated its efforts, so that it had not quite enough vitality to make a complete transformation.

The third larva spun so delicate a cocoon that one day when the comb was suddenly

turned down, the silken cap could not hold the weight of the now motionless pupa, and it fell crashing through, — an accident which terminated fatally, as once exposed to the air it could not transform.

The fourth larva gave up the unequal contest and died without attempting to spin, and the one that spun first also died in its cell without developing its wings.

It is an easy matter to tame Polistes, particularly if the nest is taken early in the season before many wasps have hatched out.

Although the adult wasps were all removed from the nest described, others soon hatched out and they were so tame that the nest could be picked up while they were on it without exciting their displeasure.

The drones that hatched from this nest all had white faces, although the faces of the other wasps were brown.

Like other drones these also had long antennæ, by which, and their white faces, they could be recognised at a glance.

Sir John Lubbock once took a specimen of *Polistes* with her nest, in the Pyrenees early in May. She became very tame, and lived till near the end of February.

Sir John Lubbock's account of her death is quite touching.

"One day," he says, "I observed she had nearly lost the use of her antennæ, though the rest of the body was as usual. She would take no food. Next day I tried again to feed her; but the head seemed dead, though she could still move her legs, wings, and abdomen. The following day I offered her food for the last time; for both head and thorax were dead or paralysed; she could but move her tail, a last token, as I could almost fancy, of gratitude and affection.

"As far as I could judge, her death was quite painless; and she now occupies a place in the British Museum."

Like Vespa, Polistes leaves the nest at the approach of cold weather; the queens, after mating, find a safe place in which to pass the winter, and the drones play about in the sun until they succumb to the inclemency of the season.

A number of these homeless drones were once watched on a Massachusetts hillside.

They had long, drooping antennæ and white faces.

Each had its favourite rock where it took its station on the sun-warmed south side, and none would allow another to come near its place.

When one, perhaps tired of his own rock, tried to sun himself on his neighbour's boulder, there was trouble. The invaded wasp flew at the intruder; they grappled and rolled head over heels among the leaves; then the original occupant returned in triumph to his rock, and the intruder flew away.

There was room enough on each boulder for any number of wasps, but only one might sit there at a time.

The observer could not decide whether some favourite wasp game, like foot-ball or tennis, was being played, or whether these drones really hated the sight of each other.

Polistes is a wise little creature in the things that pertain to wasps, and Mr. Belt has told an interesting story of the intelligence of one of the family in finding her way back to an object she had left.

He says, —

“A specimen of *Polistes carnifex* was hunting about for caterpillars in my garden. I found one about an inch long and held it out towards it on the point of a stick. It seized it immediately, and commenced biting it from head to tail, soon reducing the soft body to a mass of pulp. It rolled up about half of it into a ball, and prepared to carry it off. Being at the time amidst a thick mass of a fine-leaved climbing plant,

it proceeded before flying away, to take note of the place where it was leaving the other half. To do this, it hovered in front of it for a few seconds, then took small circles in front of it, then larger ones round the whole plant. I thought it had gone, but it returned again, and had another look at the opening in the dense foliage down which the other half of the caterpillar lay. It then flew away, but must have left its burden for distribution with its comrades at the nest, for it returned in less than two minutes, and making one circle around the bush, descended to the opening, alighted on a leaf, and ran inside. The green remnant of the caterpillar was lying on another leaf inside, but not connected with the one on which the wasp alighted, so that in running in it missed it and soon got hopelessly entangled in the thick foliage.

“Coming out again it took another circle, and pounced down in the same spot

again, as soon as it came opposite to it. Three small seed-pods which here grew close together formed the marks that I had myself taken to note the place, and these the wasp seemed also to have taken as its guide, for it flew directly down to them, and ran inside ; but the small leaf on which the fragments of caterpillar lay, not being directly connected with any on the outside, it again missed it, and again got far away from the object of its search. It then flew out again, and the same process was repeated again and again.

“Always when, in circling round, it came in sight of the seed-pods down it pounced, alighted near them, and recommenced its quest on foot. I was surprised at its perseverance, and thought it would have given up the search ; but not so. It returned at least half a dozen times, and seemed to get angry, hurrying about with buzzing wings.

“At last it stumbled across its prey, seized it eagerly, and as there was nothing

more to come back for, flew straight off to its nest, without taking any further note of the locality. Such an action is not the result of blind instinct, but of a thinking mind, and it is wonderful to see an insect so differently constituted, using a mental process similar to that of man."

Although *Polistes* is the only paper-maker in this country, excepting a species in California that builds unprotected combs, in other parts of the world may be found a number of species.

In Java is a social wasp that constructs a nest of three stories, very much like the arrangement of combs in the nests of the *Vespæ*; only, this nest is not enclosed, and hangs suspended by a long, slender, central pedicel.

In South America, too, is found a pretty little nest hanging like a bell from a long, slender handle.

Very likely these long, slender stems in hot countries are useful in protecting the wasps from the incursions of ants that swarm everywhere in tropical places.

The wasps could strike off the ants as they travelled down the slender support.

There are about half a dozen species of *Polistes* in the United States, and some fifty more in the rest of the world, but they all live essentially alike, building their paper nests in convenient places.

Some of the *Polistes* build circular combs, but other species have the curious habit of making oblique combs, with the pedicel attached at one end instead of in the middle.

PART II

THE SOLITARY WASPS

Part II—THE SOLITARY WASPS

THE MASONS

THE mason, or mud-building, wasps occupy themselves as their names imply.

They are solitary in their habits, and since they do not dwell together in communities, there are no workers among them, only males and females.

The female is unquestionably the head of the family; she does the whole work of nest-building and provisioning, and has everything her own way.

The male seldom appears upon the scene; he is necessary, but on the whole superfluous in the hard work of life, and he dies in the fall, leaving his partner in undisputed possession of the hereditary family estates, to locate her house as she pleases, and to furnish it as suits her.

The "mud-dauber" is the best known of the solitary wasps, as it makes itself at home in our attics and outbuildings, where it constructs the little mud nests so familiar to every one.

It belongs to the division of digger wasps, and while in a general way these are constructed like the true wasps, they differ in certain particulars.

Unlike *Vespa* and *Polistes*, the eyes of the daubers are not cut across by a semi-lunar line, but are large and projecting; and unlike the true wasps in general, the wings of the mud-dauber, as of all the diggers, are not folded fan-like down the middle.

There are a number of minor characteristics distinguishing the digger from the true wasps, but the wings are the most readily observed, and are enough for ordinary purposes.

The mud-dauber, or *Pelopæus*, is in appearance an elegant dame.

She has a very long and very slender waist, — a ridiculous waist, that long ago caused Aristophanes to compare fashionable women to wasps, calling them what has been translated as “wasp-waisted wenches.”

Pelopæus’ legs are long and slender, and ornamented with spines.

As if conscious of the elegance of their personal appearance, the mud-daubers continually jerk their wings with a self-satisfied little flirt that is as amusing as it is characteristic.

Why should not a wasp as well conditioned as a mud-dauber flirt its wings at the rest of the world? It should, and it does.

It flirts its wings, but it does not use its sting unless forced to, and it soon becomes tame and friendly with the right kind of people.

Pelopæus cementarius, very abundant in country places, is a pretty, brown creature with yellow legs.

She may be seen in the summer gathering mud for her nest from the edges of mud-puddles or ponds with muddy banks, or even from the edges of drains; in fact, from almost any place where she can obtain it. She is not at all particular about the quality of her mud, all she asks is mud.

The places she frequents betray her presence by the marks she leaves on the soft earth, for it is spotted all over, where she has chiselled out her little loads.

She is a very eager worker when she does work, and when she has found a spot to her mind she falls upon it with vigour, and cuts out a little pellet about as large as a sweet-pea seed with her jaws.

In her earnest devotion to her work she rams her head down under the edge she has loosened, and literally stands on her head while she completes the separation of her pellet.

It is a curious sight to come upon a mud-bank in the summer and find it lined

with brown wasps standing on their heads and waving their tails in the air.

The uninitiated observer might imagine this to be some strange wasp-rite, but it is merely Madam Pelopæus getting a load of mortar with which to build her walls.

Often she spends considerable time running up and down the bank looking for just the right spot from which to gather her load. And sometimes she starts to dig it out from several different places, abandoning them one by one until she finds mud of a consistency quite to her liking.

Occasionally she strikes a large grain of sand or a little pebble, and this causes her to use what one fears is rather strong wasp language. She flirts her wings, buzzes vehemently, and flings the obstruction away in a manner that well expresses her feelings, if wasp gestures mean anything at all.

As she works she curls up her precious antennæ so that the delicate tips cannot come in contact with the earth.

Sometimes her load is so large that she is obliged to hold it in place by clasping her forelegs about it.

When she has her little ball in her jaws, she flies home.

Her load is so heavy that she is tilted down by it, her head often being much lower than the rest of her body. Up goes her tail, down goes her head and she speeds away on hurrying wings, soon lost to sight, unless her nest happens to be very near the mud upon which she is working.

Mud-daubers once made their nests under the roof of a small shed, coming in and going out through a little window at one end. And here it was discovered that they, too, have their troubles.

The wind was blowing, the window was small, and as the laden wasp neared the

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opening, the wind caught her and blew her away.

Often she had to try several times before she could make port. When carried past the opening, she made a wide circuit and sometimes stopped for a moment to rest. Then she put on all steam and headed for the window again.

Once in, she ran up the wall of the shed to her unfinished mud-cradle at the top, and proceeded to apply her load.

She laid the mud down with her jaws, apparently moistening it with a liquid from her mouth, and all the time she was at work she sang merrily.

The mud-dauber always sings at her work.

Her song may be expressive of peace and happiness from a mud-dauber's point of view, but to the unskilled interpretation of man it has rather a sound of intense anxiety, as though she were keyed up to the highest pitch and were

venting her feelings in a querulous outcry.

Indeed her voice during the process of nest-building is a shrill, high-keyed buzzing not unlike the sound made by a large fly when caught in a spider's web, and it often leads to her detection when she is building in concealed corners.

One summer, mud-daubers' nests were searched for in vain. They are always common enough — until one begins to look for them. Because they were wanted that summer — or for some other reason — they could not be found.

The wasps themselves were abundant, and were seen constantly at work in a muddy place near the barn pump. But where they took their pellets of mud was another matter. Not a mud-nest was to be found in the barn or in the attic of the house.

There seemed no solution to the mystery until it was one day unexpectedly

solved. The voice of a wasp was heard buzzing out its high-keyed song of industry, though no wasp could be seen. At first the tell-tale song was dismissed as the crying of a fly in distress, but when it recurred again and again search was made and the sound traced to one corner of the attic, where at length her ladyship was discovered working for dear life over a rafter, between that and the shingles.

She had found a hole somewhere in the roof, and had chosen this most secret and safe retreat. At least it would have been secret had she kept quiet, and it was safe enough, as it was impossible to get it without unroofing the house. Although the Pelopæus of to-day has learned to use the roofs provided by man, where there are none handy she finds a dry shelter under a stone or in the stump of a tree, and there makes her mud cradles, this doubtless having been her habit in those long ago times, when wasps existed, but

men's houses had not yet covered the earth for the benefit of the little masons.

After applying the load of mud in the little shed, Pelopæus flew out to the roof of another shed, settled on it in the sun, cleaned her face and hands, then settled herself, apparently for a nap.

It was a very short nap, however, for suddenly starting up, she flew quickly to a near mud-hole, worked as if her life depended on it, flew home, and in the same eager, restless way applied her load of mud to the nest. Then she rested on the sunny roof again. She averaged about two loads a minute including her nap.

In order to see her build, it was necessary to stand on a box close to the nest, and with the head of the observer quite close to the roof. When Pelopæus came in at the window and saw this strange, immense, living object so near her nest, she did not understand it. She flew straight at the face of the intruder, who,

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as may be supposed, fairly held her breath and steeled her nerves to receive as composedly as possible a deliberate and well-deserved stinging.

But wasps seldom sting if they stop to deliberate, and Pelopæus certainly was not anxious to imperil her future by stinging unnecessarily, and thereby risking the loss of her sting, which is also her ovipositor, and which is in danger of being left in the wound if she uses it for purposes of discipline.

She poised in front of the intruder's face so close that it was trying, to at least one of the actors in this little drama, to maintain the situation. Not a motion betrayed the fact that Pelopæus' strange visitor was alive, not a muscle moved, and, perhaps concluding she had mysteriously encountered some sort of mummy or ghost, Pelopæus went about her business — and allowed the intruder to remain about hers.

The door to the shed having been left open, the wasp when her work was done flew out at the large opening, but she never came in that way. She always appeared at the little window, battling with the wind and holding on to her precious load of mud, although had she gone around to the side of the shed she would have found a much easier entrance.

She brought load after load in against the wind and built the walls of her oblong cells, making each just the right size to contain a pupa, although the wasp occupant began as a tiny egg, and the mother

wasp had no experience of it in any other form. She built three or four cells side by side, then above these she piled others, making two or three tiers. Each little mud cave had a round opening at one end.

Generally the pile of cells was all plastered over into a shapeless mass before the

wasp got through with it, perhaps with a view to strengthening the whole, though sometimes the cells were distinct, as at first made, with pretty braided roofs. For the mud was laid on in strips, first one side and then the other, giving a braided effect to the result.

As soon as a cell was completed, it was stocked with provisions and the opening shut up with a pellet of mud.

The mud-dauber does not give her offspring personal attention. She does not come day after day and put food into ever-open mouths. Being quite alone in her maternal duties, she cannot possibly rear her family and defend them after the manner of the Vespæ. She takes care of them, but it is after her own fashion. She catches spiders, and fills the little mud cell full. Upon one of the first caught, she deposits an egg. This is usually attached to the succulent abdomen of the spider, and when the cell is as full as it can be,

the end is sealed up, and the egg left to take care of itself.

The mud-dauber cannot store up active spiders, or the tables might very quickly be turned, and Pelopæus' tender offspring become converted into spider, instead of the reverse happening as intended.

So Pelopæus catches her spider and stings it. Generally she does not kill it at once, but stings it enough to paralyse it; in which state it remains as fresh food for the larva, though, truth to tell, that ravenous infant does not seem to care much whether its food is alive or not. It devours dead spiders as eagerly as living ones. Mother Pelopæus has learned the trick of stinging spiders to perfection: grasping her indignant and resentful prey, she thrusts her poisoned dart into its nerve centres so as to quiet it at once. Many people believe the wasps sting the insect

used as food on purpose to paralyse, and not to kill it. Since in nearly all nests a part — and sometimes all — of the spiders are dead, and since the larvæ eat the dead as eagerly as the living, it is probable the stinging is done, primarily, for the purpose of quieting the spiders as soon as possible.

The egg in the mud cell hatches in two or three days, the larva breakfasts, dines, and sups on abundance of fat spider, and grows apace.

When the larva begins its gastronomic operations, it is a little oblong white object without legs, lying in a room tightly packed with luscious spiders. When it ends its gormandising, the cell is still filled, but not now with spider — in the form of spider. The spider has been duly converted into wasp. When, by some chemical and vital action, the tiny white larva

has changed into a large fat one that almost fills the cell — all the spiders have been consumed. Not even the legs have been omitted, but all that was spider has been reduced to food by the powerful digestion of the ever-hungry larva.

Nothing now remains but a young glutton, which, having devoured its whole store of provisions, fortunately discovers that it no longer craves food. It craves rest and a snug retreat. From its lip exudes a fluid that upon exposure to the air hardens into silk. It moves its head restlessly; wherever its mouth touches the wall of the cell,

a thread of silk is drawn out. Soon it begins to spin in earnest, and forms a loose lining to its cell. Then it forms a close, dense covering about its body. At first this covering is nearly white, but it soon changes to a dark-brown, brittle case, that looks like the shell of a butterfly chrysalis, excepting that it is very fragile

and almost transparent. Within this shell the marvellous transformation takes place that changes a white, legless grub into a perfect wasp, with its complex legs, eyes, antennæ, and sting.

When the transformation is complete, the wasp bites a hole through the end of its cell, moistening the hard mud with a liquid from its mouth, the delicate pupa skin that covers it is broken off, and it comes forth into the world to see what is next to be learned of life.

There are about an equal number of male and female mud-daubers hatched in a season, and like other wasps, the male mud-daubers have no stings.

Soon after coming from the cell the wasps mate, and the female begins to make mud cells.

If the eggs are laid early in the summer, the wasps hatch out and go to work at once to build nests and lay their eggs. If, however, the egg is laid in the fall, the

pupa lies all winter in its cell, not coming forth until the following spring.

The mother wasp dies soon after the eggs are laid, but if she is hatched late in the season and does not lay her eggs, then she crawls into some safe crevice and lies dormant, like the queen vespa, until spring.

Egg-laying seems to be the culmination of an insect's life, and nearly all of them die as soon as the eggs are laid and the future of their race is thus assured. The wasp is no exception to this general rule; she will live through the winter in order to lay her eggs the following season, but if she lays them she dies at the approach of winter. The queen bee, that lives several years, is one of the few exceptions to the rule. Generally the mud-daubers build new cells for their progeny, but individual wasps differ as much as individuals of any other race of animals; and occasionally one will use an old nest, cleaning out the

mud cells and restocking them with provisions, thus saving the labour of carrying mud for a new nest. A number of queens have even been observed working amicably together, clearing out and re-fitting the cells in a large cluster left over from the season before.

In the fall of the year the female mud-daubers often come into the houses and crawl into clothes that may be hanging in a room.

Occasionally some one puts on a garment which contains one or more of these seekers after a cosy winter retreat, when the consequences are more amusing to the onlookers than to the victim.

However, the sting of the mud-daubers does not amount to much, unless a great many of them are received at once, as in the case of a gentleman who put on a suit of clothes that had been hanging in a closet for a week. All unsuspecting of the dozen wasps that had chosen his gar-

ments for their winter home, he went out to dine in state at the house of a friend. He was no sooner seated at the table than the wasps, yielding to the genial warmth of their new surroundings, waked up. One by one they began to avenge the wrong done them, and with perspiration on his brow and anger in his heart, the gentleman was compelled to make a precipitate exit, leaving explanations for a future and more auspicious occasion.

The mud-daubers in the little shed had a good deal of difficulty in finding spiders with which to stock their nests. They preferred a certain plump yellow-and-brown variety which builds a circular web, and upon which they pounced as it sat in the middle of its nest, hoping itself to pounce upon some hapless insect entangled by its silken threads.

The wasp swoops upon the spider like a hawk upon a bird, snatches *Arachne* away, and plunges a poisoned sting into her

vitals before the little spinner knows what has happened. Sometimes Pelopæus in her extremity darts at an empty web, as if hoping against hope that some toothsome spider might be lurking near.

The mud-daubers sometimes close the end of an empty cell until they are ready to fill it. This is evidently done to keep out trespassers.

A very amusing quarrel was once watched between two mud-daubers that both wanted the same cluster of cells. Whether they had built the cells in common, or whether one had built them and the other had decided it was easier to occupy them than to build some for herself, is unknown.

But at the time they were discovered one was sitting on the nest, evidently waiting to pounce upon the other. Whenever Number Two appeared, Number One would "go for" her, and a lively skirmish would ensue, Number One holding the

fort, and going back to sit in triumph on her castle wall, after having chased Number Two away.

As all the cells were closed and no new ones being made, it was not at first apparent what the fuss was about. Presently, however, Number One, having been left in peace for a few moments, began to tap the cells with her antennæ, and finally she began to gnaw a hole in the end of one of them. What did it mean? Was she uncapping her rival's cell? Did she mean to destroy the helpless larva and scatter the enclosed spiders?

The observer watched with breathless interest until finally a round hole was so neatly made that the cell looked exactly like one that had not yet been capped. And lo! this cell was empty! The wasp went in and examined it; evidently finding all as she had left it, she flew off and soon returned with a spider which she deposited in the far end of the cell, after

a long struggle with the booty, which was almost too large for the little store-house, and which appeared to have too many and too long legs for the use to which it was being put.

The wasp's own legs and wings were also superfluities in this particular walk of life, and though she could go in easily enough, when she struggled out backwards, they seemed on the point of being torn off and left behind with the spider in the cell. One wished she could unhook her members and hang them up outside, though such an arrangement would very likely have resulted in her complete overthrow, as Number Two undoubtedly would have run away with them, and thus have had Number One in her power.

As it was, Number One managed to struggle free with all her parts upon her, and this done she stood on the cell and looked around. Meantime Number Two

had hidden behind the mass of cells, and there she remained until Number One flew away, when she at once appeared and went

and put her head into the open cell as if to see what had been going on there. She appeared to want to go in and pull that spider out — but it was tucked away at the far end and she probably dared not trust her person in a position of such advantage to a vindictive foe.

Well for her she did not, for while she was still investigating, along came Number One with a second spider, and away ran Number Two.

The spider was crowded into the nest with the same trouble as to superfluous legs and wings on the part of captor and prey as before, then Number One, suspecting Number Two, made chase for her. There was a skirmish, in which the two grappled and rolled head over heels, Num-

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ber Two finally dropping to the ground, and Number One going for more spiders.

Number Two was not out of the combat for good, however. She promptly returned to the nest, went to the back of it, gnawed into a closed cell, triumphantly hauled out a spider and flew off with it. She did not eat it, but flying to a bush near at hand, she dropped it and returned to the nest.

Did the spider so cast out contain the egg of her hated rival? The observer made a faithful search for the discarded spider, but it was impossible to find it in the thick foliage of the bush.

The case was getting serious; the wasps fought constantly, and the one that was carrying spiders was so disturbed that there was little probability of the nest being completed, when the observer came to the rescue. Troublesome Number Two was incarcerated in an insect net, which mishap, no doubt, greatly rejoiced the

heart of Number One, who continued her labours zealously; and next morning the cell was found closed for good, with a cap of mud of much darker colour than that of which the rest of the cell was built.

Mud-daubers' nests are often built of several shades of mud, sometimes one set of cells being curiously patched with light and dark colours. Sometimes the nests are built of sand, held together, perhaps, by a secretion from the wasp's mouth, and once a cluster of nests was found, in which four were composed of white plaster, this material the wasps having recognised and appropriated as an admirable material for nest-making.

In the red-clay country of the Carolinas the nests are bright red, and make very pretty decorations to the interiors of the houses; at least, so think some people. Others hold another opinion, and fall upon these red nests and break them to pieces,

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and try — in vain — to remove all traces of their presence.

All the mud nests are very friable and easily broken, so that it is difficult to remove a cluster of them without destroying some. The mud of the nests does not seem to be glued together with secretion from the wasp's mouth, at least not as a rule, but merely dries, and thus keeps its form. It is moulded solidly, so that when dry it is strong enough for the purpose unless it happens to be placed where, through some accident, the rain wets it, in which event it quickly falls to pieces.

In taking down the cells in the little shed the lower tier was broken, and a larva left exposed in one cell, while a pupa in its shell was exposed in another. The anxious mother, returning to finish her last cell and finding the whole fabric gone, with only these luckless infants left and exposed to a merciless world, at once set to work plastering them up again. Evi-

dently feeling that the half-grown larva was a lost wasp anyway, she wasted no time on it, but relentlessly walled it up, or rather floored it over, with not a spider to stay its appetite, and proceeded to build another cell above it.

The pupa, however, she covered over with mud, reproducing its lost cell as well as she could, doubtless feeling that all it needed was to have the cold air kept out, in order to surmount its misfortunes and in time fulfil its destiny.

When a mud-dauber begins to provision with one species of spider, it continues with the same species, and even selects subjects all of a size as nearly as possible. Thus the inside of the nest presents a very orderly, and were it not for prejudice, appetising appearance.

The mud-wasp's habit of provisioning her cell with insects gave rise to a strange superstition in China, and also in India.

She was seen putting the insect in her nest and sealing it up there, but that she laid an egg on it was not known.

It was consequently believed that she transformed the insect into her own progeny, and as she plastered up the opening, hummed a song over it saying, "Class with me, class with me." Gradually the transformation took place, until a perfect wasp emerged the following season.

The mud-daubers are easily tamed if taken in time. Once a nest was kept in a room so warm that the first wasp began to gnaw out while the outer world was still under a blanket of snow. When its head began to appear, young Pelopæus was helped out with a pin. Its antennæ were stroked and touched with the finger, and it was given a drop of honey on the tip of the same finger.

Finally Pelopæus crawled out on the warm hand of her human friend. The warmth was grateful to her and she stayed

there as long as allowed. She was transferred to the window, but from time to time fed from her owner's hand and was allowed to creep into the warm palm and stay a little while. She soon learned to come for her meals, and never missed an opportunity to heat her sluggish blood in the palm of her friend. Indeed she did not always wait for an invitation, and it was necessary to keep on guard so as not to close the hand suddenly, thereby, perhaps, squeezing and frightening a live wasp, that might suddenly remember she had a sting to be used when the world went wrong with her, although she did not seem to know she was possessed of a defensive weapon.

But one sad day, the maid, not being acquainted with Pelopæus, put her out of the window. Meantime another wasp had hatched out unobserved. Pelopæus' owner, coming in and seeing, as she supposed, her little pet upon the window, picked up the wrong wasp!

Now, though the *Pelopæus* is the most gentle of creatures to those she knows, even she could not be expected to submit without preparation to being handled by a fearful great monster that seemed about to destroy her. The new *Pelopæus*, frightened out of her wits, no doubt, instantly took the defensive; all the worst attributes of a wasp's nature came to the front. She, an untamed *Pelopæus*, had been treated like a tame one, but she did not act in the least like a tame one, and as the friendly hand closed over her irate person—it may be well to draw a curtain over what followed.

Pelopæus cementarius, though very common, is not the only common mud-dauber. There is a brilliant blue creature, *Pelopæus ceruleus*, not quite so slender and elegant in form as *cementarius*, but of such rich colouring that she makes up in brilliancy what she lacks in form. Her body, legs, and head are a deep

metallic blue, and her wings are also blue, with lovely purple lights on them.

She is fond of finding her way into attics and under roofs, and there making her little mud-nests. In some sections of the country she is even more common than cementarius, and the habits of the two are quite similar.

Indeed, all the mud-daubers live and work like members of one family.

They all require a great deal of water, and they are not at all particular about the purity of their drink. A thirsty cementarius once flew to a paint-box, and alighting in one of the compartments containing a vivid blue paint, there drank deep draughts with evident satisfaction.

One cannot help wondering what might have been the consequences if she had been kept on a diet of different coloured paints. Would she have become brilliantly variegated; as some flowers do when their stems are put into coloured water, or would

her life have paid the forfeit of a too free indulgence in bright waters?

There is a black wasp, less often met with than the common mud-dauber, that builds galleries several inches long. Each gallery is partitioned off into compartments about the size of the mud-dauber's cell. The galleries are placed vertically on the side of a door-post or elsewhere, and the little architect lays out the plan of her house before building it. That the gallery may maintain its proper width and be kept straight, two parallel lines of mud the right distance apart are first laid down and upon these as guides the arch of the tube is built.

This mud gallery is very prettily braided, and is not defaced by being plastered over. Sometimes several galleries are built side by side touching each other. Sometimes the tube is built to its full length before

being divided into partitions, and again the partitions are made as her ladyship advances.

When the tube is fairly started, if she does not want to wait for its completion before laying in provisions and depositing eggs, the wasp fills the end of it with spiders, lays her eggs on one of them, builds a thick mud partition, and proceeds to lengthen the tube. As soon as it is long enough she stocks the next compartment, and closes it, and thus continues until she has finished five or six cells.

All the cells, or compartments, are of the same size, and each is just the size to hold a pupa.

The wasp sings loudly as she builds her pretty apartment-houses with their braided roofs.

These nests cannot be removed unbroken, as the surface upon which they rest forms the floor, and as there is no

second tier of cells, if the nests are disturbed all of the occupants are exposed to the air, which is fatal to their lives.

The young of these wasps develop and spin their cocoons the same as those of the common mud-daubers.

There is a pretty little creature belonging to the family of the true wasps, that makes a nest of mud or clay in the form of a tiny vase, and many a time the dainty piece of pottery has been found on a bush and wondered over.

The little vase is stored with insects, an egg is laid on one of them, and the mouth of the jar is sealed. Sometimes a whole row of these pretty pygmy vases are found on one twig, though more often but one is found at a time.

There are a number of small wasps that have most interesting and sometimes

troublesome habits, as in the case of that *Odynerus* that seems specially devoted to plastering up keyholes!

It provisions the inside of the lock with fresh stung insects, lays its egg, and to make all secure carefully plasters up the keyhole with moist mud that soon dries into a hard mass that resists the entrance of all disturbers, keys included.

One of these wasps once added materially to the interior decoration of a beautiful cabin in the Blue Ridge Mountains. This cabin was finished with pine inside, and there were many screws used, the heads of which were sunk a quarter of an inch in the wood. The place was not used during the summer. Here was opportunity indeed for wasps that preferred to exercise their intelligence rather than their muscles. No hard work for them! They merely provisioned those holes and sealed them up. When the cabin was opened next spring it was found

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elaborately decorated with round white circles over all the screw-holes.

One *Odynerus* in this country makes a many-compartmented mud-nest as large as a hen's egg, and attaches it to a bush.

The mud-wasps make a separate cell for each larva, and this great amount of labour is perhaps rendered necessary by the carnivorous character of the young.

It may be true that "birds in their little nests agree," but it does not follow that wasps in their little nests agree. The probabilities are that these voracious infants, if more than one occupied the same cell, would eat each other up. Not because they were wicked, but because they were very young, and very hungry, and did not know the difference between spider and brother-larva.

Wasp larvæ eagerly feed upon each other if the nests are broken and the occupants spilled out, as happens to some

extent whenever these fragile structures are taken as specimens.

Each devouring infant having a cell of provisions to itself, it cannot eat the members of its own family, and it cannot get more than its own share of food.

Different species of mud-wasps are found in different parts of the world, and Mr. Bates in his "The Naturalist on the River Amazon," tells an interesting story of one he became familiar with in South America. He says, —

"The shallow pits, excavated in the marly soil at Mahicá, were very attractive to many kinds of mason-bees and wasps, who make use of the clay to build their nest with.

"The most conspicuous was a large yellow-and-black wasp, with a remarkably long and narrow waist, the *Pelopæus fistularis*. It collected the clay in little round pellets, which it carried off, after rolling them into a convenient shape in its man-

dibles. It came straight to the pit with a loud hum, and on alighting, lost not a moment in beginning to work ; finishing the kneading of its little load in two or three minutes. The nest of this species is shaped like a pouch, two inches in length, and is attached to a branch or other projecting object.

“One of these restless artificers once began to build on the handle of a chest in the cabin of my canoe, when we were stationary at a place for several days.

“It was so intent on its work that it allowed me to inspect the movements of its mouth with a lens whilst it was laying on the mortar.

“Every fresh pellet was brought in with a triumphant song, which changed to a cheerful, busy hum when it alighted and began to work.

“The little ball of moist clay was laid on the edge of the cell, and then spread out

around the circular rim, by means of the lower lip guided by the mandibles.

“The insect placed itself astride over the rim to work, and, on finishing each addition to the structure, took a turn round, patting the sides with its feet, inside and out, before flying off to gather a fresh pellet.

“It worked only in sunny weather, and the previous layer was sometimes not quite dry when the new coating was added.

“The whole structure takes about a week to complete.

“I left the place before the gay little builder had quite finished her task: she did not accompany the canoe, although we moved along the bank of the river very slowly.”

Mr. Bates describes a mud wasp of another genus but with habits similar to those of the *Pelopæus*, and describes also a large black kind, three fourths of an inch in length, that “makes a tremendous fuss whilst building its cell.

“It often chooses the walls or doors of chambers for this purpose, and when two or three are at work in the same place their loud humming keeps the house in an uproar.”

A little one of this genus “makes a neat little nest shaped like a carafe; building rows of them together in the corners of verandas.”

THE CARPENTERS

PRETTY little wasps, shaped and coloured more like yellow-jackets than mud-daubers, construct their nests in wood, burrowing into logs or boards and there chipping out a cavity large enough to contain the egg and its provisions.

They are usually of small size, with black, shining bodies ringed with one or more bands of yellow.

Some of them are so yellow-jacket-like in appearance that their occupation is all that distinguishes them to the eye of the hasty observer.

They are pretty, busy little creatures, very alert and quick in their movements.

Their heads are much larger in proportion than the heads of the yellow-jackets, and they have large, strong

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jaws, as is necessary to carpenters that work with their heads instead of their hands.

One spring a number of them took a fancy to drill into the logs of a cabin on a mountain top in the western part of Virginia.

The first one that appeared upon the scene was a slender little creature, about half the length of a mud-dauber.

She went about examining the log, evidently with a view to settlement.

She poked into every little worm-hole and cranny in the bark, and was a long time in finding a place to her liking.

At last she succeeded, and then the chips began to fly.

She found a little hole not large enough and not deep enough, and this she proceeded to develop into a nest.

She bit out particles of wood with her strong jaws. When she had loosened a chip or a fibre, she backed out of her hole,

flew away a few feet; and dropped it; then she returned and gnawed out another fibre, or else cut little bits like fine saw-dust.

She always crept into her hole head first, and backed out tail first, losing no time and wasting no energy in superfluous motions. And she always flew away with her chips, and dropped them some distance from her door.

Had she littered up her doorway, the traces of her labour might have betrayed her to the enemy.

For there is always an enemy lying in wait for the miners.

This enemy is an exceedingly beautiful little rascal about as large as a house-fly, and of a brilliant metallic green.

It, too, belongs to the Order Hymenoptera, though it is not at the wasp end of that division.

It is a Chrysis fly, that, instead of making a nest for itself, dogs the miner wasps, and watches with interest the progress of

its neighbour's nursery. As soon as the hole in the log is finished, the first insect stored away, and the wasp gone for another, in pops little green madam. She lays her egg in the snug retreat that cost her only vigilance to secure, and away she goes.

But woe to her if she is caught in the act, for the wasp knows her well and understands perfectly her thievish intentions, and if she so much as sees her in the neighbourhood of the nest there is trouble. The wasp makes a dash for the chrysis, but the little green rascal is so very quick in her movements that she generally escapes unharmed.

She appears to go away after this inhospitable reception, but she does not really go. She still lurks near, watching operations — and watching her chance.

If she succeeds in getting into the nest when the wasp is away she deposits her egg, and her interest in that nest is at an end.

The wasp goes on provisioning what she believes to be the larder of her own offspring, wholly unconscious that the chrysis has outwitted her, and that she is labouring for the progeny of her hated foe.

When the Virginia wasp had finished the nest, stored it with provisions and laid her egg, she carefully sealed the entrance with mud and went away, leaving her progeny to care for itself.

She spent part of two days making her nest.

At first she was shy and would not work when closely observed, but she soon lost all fear of her human friends, and burrowed away as if she had the whole place to herself. She often stopped to rest and to sip the nectar from wild flowers that grew near the door-step.

The second morning of her work was rainy, and like all her tribe, she declined to expose her person to the storm; but when the sun shone out in the afternoon, there

was the little carpenter as busy and as alert as ever.

In course of time the egg hidden with so much care in the wood hatches. The larva, in as impregnable a fortress as any one could desire, begins at once upon the delightful occupation of consuming luscious flies or aphides, or whatever delectable pabulum its mother has stored up for it.

It eats and grows. Having nothing to do but eat, and being so constituted that it does not suffer from the lack of other exercise, it grows rapidly.

Like the other wasp larvæ it is a little white, legless grub, and at length, having eaten up everything it can find, it spins itself a silken cocoon in which to undergo the transformations that will cause it to become a perfect wasp, with all the organs and powers and desires of a wasp.

Its cocoon has sometimes been found gay with the wings of the insects it has

eaten, which are woven into its silken covering; and sometimes it uses the chips of wood it may find in its nest in the same way.

Whether it considers these additions ornamental, or whether it uses them to get them out of the way, itself alone knows.

When the transformation is completed, the mud cap is gnawed away and forth from the log issues a young wasp.

These things happen to a larva into whose nest no chrysis has found place.

Where the chrysis egg is laid in the nest there is another story to tell.

The vigorous young chrysis devours the food intended for the wasp — and incidentally devours the wasp too.

Now matters go on as before, only that a changeling occupies the cradle. It eats and grows — it becomes a pupa — transforms to an adult chrysis — bites its way out through the mud cap, and comes forth — ready to try for its own offspring the

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clever but thievish experiment by which its infancy was so well nourished at so little cost to its mother.

These little green chryses are so quick in their movements that it is extremely difficult to catch them even with a net. They are outlaws by nature, and have the craft and fleetness acquired by outlaws, whether those picturesque products of nature are human or hymenopteran.

Their brilliant dress flashing in the sun betrays these wicked Robin Hoods at a glance, but they are bold and fearless, and wear their glistening attire with as devil-may-care a grace as did the outlaws of the greenwood of old.

The wasps chisel out a separate hole for each egg laid, and about an equal number of both sexes are hatched, as is the case with nearly all the solitary wasps.

The males, as is true of most wasps, soon die, leaving their mates to carry on the affairs of the family.

It is always the female that digs out the holes in the wood and catches and stings the insects she puts in as food. The male, having no sting, could not assist in the provisioning of his household even if his life were sufficiently prolonged.

The wasp leads a busy and arduous life, and also a precarious one, as witness the innumerable little nests of the various species that have been begun but never finished.

On the logs of the Virginia cabin came another species of miner wasp, smaller than the first, but otherwise closely resembling it.

This little one made a tiny hole, just as the larger one had done, but when it had finished it lined its nest with a gluey material from its own mouth and sealed it — not with mud — but with a glistening substance like the lining.

It was not discovered what these nests were provisioned with, as neither wasp was caught in the act of carrying in its booty, and it would have been very difficult to cut the nests out, as well as disfiguring to the cabin.

Another miner wasp, with a strikingly yellow-jacket-like appearance, was seen later in the summer carrying something into a little hole between the shingles on a New England sea-shore house.

She went in so quickly, however, that it was not possible to discover the nature of her victim. When she had carried in a number of small insects she closed the opening and went away.

In choosing the neat little tunnel made by the shingles where they did not quite come together and were roofed over by the shingle above, this clever wasp saved herself the trouble of digging out her own hole.

But clever as she was, she may not have been clever enough to escape the brilliant green little rascal that lay in wait. For she too had her chrysis, that ran swiftly about in her absence, evidently scenting the wasp whose retreat she could not find. Whether Robin Hood did or did not find the right hole between the shingles in time to defraud the wasp of her honest labours, could not be discovered.

The carpenter or wood-boring wasps frequently use any convenient opening for their nests, some having been discovered occupying holes in the mortar of a brick wall.

Trypoxylon is a slender-waisted black little carpenter, ornamented with a red girdle in one species, and with white hairs on her legs in another. The red-girdled *Trypoxylon*, or *rubrocinctum*, was one summer watched making her nests in a straw-stack. "The stack had been cut off perfectly smooth on one side, so that many

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thousands of the cut ends of the straws were exposed to view, and these proved very attractive to *rubrocinctum*."

These wasps provision their nests with spiders, and with mud partition their tunnels into compartments. With them the males are not the idle members of society that they are with so many of the wasps. The female still makes the nest, or selects the straw, as the case may be, provisions and partitions it, but greatly to his credit be it said, "When the preliminary work of clearing the nest and erecting the inner partition has been performed by the female, the male takes up his station inside the cell, facing outward, his little head just filling the opening. Here he stands on guard for the greater part of the time until the nest is provisioned and sealed up, occasionally varying the monotony of his task by a short flight. As a usual thing all the work is performed by the female, who applies herself to her duties with

greater or less industry according to her individual character; but the male doubtless discharges an important office in protecting the nest from parasites. We have frequently seen him drive away the brilliant green *Chrysis* fly, which is always waiting about for a chance to enter an unguarded nest. On these occasions the defence is carried on with great vigour, the fly being pursued for some distance into the air. There are usually two or three unmated males flying about in the neighbourhood of the nests, poking their heads into unused holes, and occasionally trying to enter one that is occupied, but never, so far as we have seen, with any success, the male in charge being always quite ready and able to take care of his rights. The males, however, made no objection when strange females entered the nest, as they sometimes did by mistake, nor did the females object to the entrance of a strange male when the one belonging to the nest

happened to be away, but in such cases the rightful owner, on his return, quickly ejected the intruder. We often amused ourselves, while we were watching the nests, by approaching the little male, as he stood in his doorway, with a blade of grass. He always attacked it valiantly, and sometimes grasped it so tightly in his mandibles that he could be drawn out of the nest with it.

“When the female returns to the nest with a spider the male flies out to make way for her, and then as she goes in he alights on her back and enters with her. When she comes out again she brings him with her, but he at once re-enters, and then, after a moment, comes out and backs in, so that he faces outward as before.

“In one instance, with *rubrocinctum*, when the work of storing the nest had been delayed by rainy weather, we saw the male assisting by taking the spiders

from the female as she brought them, and packing them into the nest, leaving her free to hunt for more. This was an especially attentive little fellow, as he guarded the nest almost continuously for four days, the female sometimes being gone for hours at a time. On the last day he even revisited the nest three or four times after it had been sealed up."

These wasps sing merrily while packing away the spiders in their narrow tunnels, and in the case of those inhabiting the straw-stack, the little mother often searched for some time before finding her own particular straw, sometimes going into other wasps' straws a number of times before coming to her own doorway. One should think it might be puzzling to locate the exact straw out of a whole stack of them. And this straw-stack was estimated to be the mausoleum of from six to twelve thousand spiders!

While most of the wood-borers are

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small wasps, there are some giants of the race that bore holes several inches long in solid wood, and naturally these are not regarded with favour by man, as they spoil the timber into which they tunnel.

One sometimes breaks the dry stalk of an elder, bramble, sumac, or other pithy plant, to find the central cavity partitioned into compartments and stuffed with motionless insects. The meaning of this is evident. One of the carpenter wasps has been at work fitting up its nursery; for certain species of them prefer a hollow twig to any other building-place. Somewhere in each compartment is an egg, or it may be a larva has already hatched and is contentedly eating its way to adult waspdom through its roomful of stored-up insects. Later these larvæ will have spun themselves cocoons, and will go through the pupal stage common to all

wasps, and later with their strong adult jaws will gnaw out of their prison cells, and soon after will gnaw into other dead branches in the interest of their own progeny.

A very pretty story is told about one of these little stem-tunnelling wasps, the *Crabro stirpicola*, a tiny creature only a quarter of an inch long, with a black-and yellow banded body and yellow legs. She was found at half-past five o'clock in the afternoon, when she had just begun her excavation. "Her manners were an agreeable contrast to those of the wasps that we had been watching through the day. The feverish excitement of their ways seemed quite in keeping with the burning heat of noon, while *Crabro's* slow and gentle movements harmonised perfectly with the long shadows of evening."

But *Crabro* was persevering, if not tempestuous; she bit out the pith with her

jaws, and when a quantity had accumulated, backed out, pushing it behind her and kicking it away with her hind legs. The hours wore on and still Crabro bit and shoved and kicked out pellets of pith. Others might sleep at night and work like whirlwinds in the daytime; she, calm and steady, worked all night long, and all the next day, and all the next night, and part of the third day, stopping only ten minutes for refreshments during her forty-two-hour task.

She was watched closely all this time, a bottle to catch her chips being put over the stem at night to record her progress, and if she grew not weary her observers did. "We began to wonder if she would ever finish her task. Wonderful though she was, we had grown a little weary of our long session of watching. We had been glad that she worked through the first night; it was creditable to her and interesting to us, and we admired her even

more for sticking to it through the second, but when it looked as though we might have to remain by her side through another long day, watching an endless series of loads as they were carried out, we confess that we thought she was rather overdoing it. Gradually, however, she slowed up her work, taking two or three minutes to make a journey down and up. At last, at just nine o'clock, her head appeared at the top of the stalk, and after a slight hesitation she flew away. The nest was completed."

This industrious pygmy is quite an exception in wasp annals, for as a rule the wasps retire at sunset and rest until the sun is well up in the morning, though the social wasps under pressure of communal cares sometimes fly until it is quite dark, and are abroad at daybreak.

All will agree that *Crabro Stirpicola* deserved the eulogium passed upon her by her patient watchers: "Surely she takes

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the palm for industry, not only from other wasps, but from the ant and bee as well."

Although the nest was excavated, little Crabro's labours were not over, for it had to be provisioned, and for the next three or four days she was industriously seeking, catching, and storing flies. Let us hope that between times she rested on some lovely flower-cluster, and refreshed herself with nectar.

The end of her little drama is tragic, as so often happens with the wasps. She succeeded in stocking one cell, laying one egg, and closing the compartment with pith, and that was all; she went forth never to return. What happened to her, nobody knows, but somewhere in the big world where evil creatures lie in wait for little wasps, she met her death.

Her tunnel was thirty-nine centimetres in length, long enough to allow of ten

or twelve compartments, one above another.

Where wasps partition long tunnels into a number of cells, the egg last laid is near the entrance, and one wonders how the wasps from the first-laid eggs at the other end of the tunnel are able to get out. In wasp life this seemingly difficult problem has been easily solved.

The wasp from the last-laid egg is the first to mature.

The last wasp in is the first wasp out. The one next behind matures next, gnaws through its cap, finds itself in its neighbour's empty cell, through which it crawls to the outer world. The next wasp in succession comes through two empty cells, and so on, until all are safely out. Usually there are not more than four or five of these adjoining compartments.

Wasps use a variety of materials in lining and closing their cells. Some are

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found lined with a white, cottony, felt-like substance, some with a gluey material, some with a silken, web-like substance, and some are not lined at all.

To those having time and inclination, there is opportunity for much original investigation in the habits of the solitary wasps.

THE MINERS

THESE wasps dig tunnels in the ground.

One sees them, in the hottest part of the summer, working as if the intense heat were the power that put them in motion. The hotter the day, the more fiercely they work, and when not digging they are flying swiftly about as if looking for some-

thing they were in desperate need of finding, and finding right away. One cannot help noticing them, particularly as some of them are of very large size and present a most formidable appearance. They are all harmless, however, if let alone. The solitary wasp will never go out of its way to sting. Queens, whether bees or wasps, do not carelessly risk the loss of the sting, which is also the ovipositor, its loss entailing the destruction of the mother insect,

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and of course of her possible progeny. The solitary female wasps are all "queens"; that is, all perfect, egg-laying females.

The wasps that dig in the ground have long legs furnished with spines or brushes of hairs, by means of which they dig holes or brush away or smooth over the earth at the entrance to their nests. They are very energetic creatures, some of them completing a tunnel three or four inches long in an hour or two, though some are more deliberate by nature and spend a day or two completing their underground nurseries. Sometimes they use their jaws not only to loosen the earth, but to remove it from the entrance to the nest. Even here the legs are more or less useful in kicking away the debris at the doorway, or brushing up and smoothing over the entrance to the hole when it is finally closed, and the careful mother wishes to conceal it.

Some species use the legs far more than the jaws in excavating, and some of these

get down to their work very much after the fashion of a dog digging out a woodchuck's hole. They scratch out the dirt with such rapidity that it issues in a little jet or stream behind them.

There are a great many species of them, and while some are quite small, others are the giants of the wasp race.

One of the largest in this country is a black creature with bands of yellow on the abdomen, the *Sphecus speciosus*.

It digs burrows two feet or more long, and provisions them with the "dog-day locust," or cicada. When her tunnel is ready, Madam *Sphecus* sallies forth, seeking whom she can conquer.

Sitting on the branch of a tree the happy cicada fills the air with its shrill and continuous song, unsuspecting the awful fate that is to bring the unmelodious perform-

ance to an unnatural end. Suddenly the wasp pounces upon the singer, the song stops short, there is a tussle, in which both sometimes fall to the ground, but during which the poor cicada receives the fatal thrust. It is now the property of the wasp, who proceeds to bear home the booty. The cicada is heavy, however, too heavy to be borne up in the air, and the wasp, knowing the advantage of an elevated starting-point in such cases, drags the heavy body up the nearest tree, and from the vantage point thus gained, springs into the air and flies home, if the nest is near at hand. If it is far away, her burden forces the wasp to the earth again, and she must needs climb another tree and take a fresh start.

Sometimes she has to climb several trees before getting home. Her tunnel ends in a pocket, where she places the cicada on its back, lays a long white egg on the under side of it, and closing the cell leaves her

progeny to hatch out and enjoy a cicada diet until it is ready to transform, which it does after the fashion of wasps, making for itself a silken cocoon and spending the winter in its snug cell under ground.

In Mexico lives an enormous digger-wasp that provisions its nest with spiders; not with the harmless fly-catching denizens of the circular webs, however; its royal prey is none other than the great hairy tarantula, or trap-door spider, that makes a hole in the ground and covers it with a door which it can open or close at pleasure. The wasp that provides this expensive pabulum for its larvæ is commonly known as the "tarantula hawk," and many a battle royal is fought between the fierce, swift wasp and the equally fierce and powerful spider. If the spider wins, as sometimes happens, the wasp supplies her hairy highness with a hard-earned meal. If the wasp wins the great spider is stung to paralysis, dragged away, and

stored in the underground nest of the wasp, to become food for the larva that hatches out of the egg laid upon the spider. If food influences character, no wonder the larvæ fed upon such nutriment develop into the fiercest of their kind.

More common than these great wasps is the beautiful *Sphex ichneumonea*, a large wasp with a long and slender waist and wearing a yellow, velvety jacket. Its legs and wings are golden brown, as is also the big end of the abdomen, the sting end being dark brown or black.

It is a striking-looking insect as one sees it flying among the fall flowers. It digs very rapidly when once it has selected a spot, and hums as it works. Although it loosens the earth particle by particle with its jaws, which are long,

slender, and sickle-shaped, it also uses its legs to carry away the débris. The earth is borne some distance from the nest and then dropped, though that which collects about the entrance hole is kicked vigorously aside when the accumulation exceeds what her ladyship considers proper limits.

When the tunnel is deep enough *Madam Sphex* flies away, but as a rule not far, for the grass about is alive with grasshoppers, and it does not take the brilliant, strong, and merciless creature long to select one, upon which she pounces. The grasshopper is quite helpless before the fate that has overtaken it, and yields its life with scarcely a protesting struggle. Having been stung and thus instantly paralysed, it is carried to the nest, dragged in, and shut up there with the egg of the wasp; for, having deposited her treasure within and laid the egg, *Sphex* scratches earth into the open end with her legs, very much as a dog might.

That wasps are possessed of strong maternal feeling can be shown by interfering with their unfinished nests, when their distress lest misfortune overtake their eggs appears as great as that of many creatures whose progeny is about them, needing their personal care.

Once the nest of *Sphex ichneumonea* was dug up before the mother had quite finished filling the entrance with earth. The marauders, who wished to examine the contents of the nest, say, —

“We had not supposed that the digging up of her nest would much disturb our *Sphex*, since her connection with it was so nearly at an end, but in this we were mistaken. When we returned to the garden about half an hour after we had done the deed, we heard her loud and anxious humming from a distance. She was searching far and near for her treasure-house, returning every few minutes to the right spot, although the upturned earth had entirely

changed its appearance. She seemed unable to believe her eyes, and her persistent refusal to accept the fact that her nest had been destroyed was pathetic. She stayed about the garden all through the day, and made so many visits to us, getting under our umbrellas and thrusting her tremendous personality into our very faces, that we wondered if she were trying to question us as to the whereabouts of her property."

Earth-digging wasps are always on the watch for parasitic enemies. Many of them close their burrows upon leaving them even for a short time, and some of them exercise great ingenuity in removing all traces of their presence or in marking the spot, probably for their own assistance in identifying it upon their return. Nor is caution unnecessary, as the parasitic flies are often seen hunting about the neighbourhood of a wasp's excavation, looking for the nest during the absence of the

rightful owner. That wasps carefully examine the location of their nests, and remember the details of their surroundings, no one can doubt who has watched them at their labours. They do not leave a new nest until they have located it, sometimes flying back several times to take a final look before going away. Once, while a wasp was gone from its newly excavated nest to look for prey, a human observer, who had been prying with great interest into the private affairs of wasp life, broke off a large leaf that partly concealed the nest, in order to see it better. When Madam wasp returned she was so much puzzled at the altered appearance of her dooryard that she could not find her hole, but flew back and forth in its vicinity, examining the surrounding objects in a state of evident excitement, until the leaf was laid back in its old position, when she at once ran to her nest.

The same observer once accompanied an *Ammophila* home through a way so intricate that the wonder was the creature ever accomplished the herculean task. This *Ammophila* was a little black wasp, with the usual well-developed intellect of the *Ammophila* folk — for of all the wasps, they are among the most intelligent.

“During the earlier part of the summer we had often seen these wasps feeding upon the nectar of flowers, especially upon that of the sorrel, of which they are particularly fond, but at that time we gave them but passing notice. One bright morning in the middle of July, however, we came upon one that was so evidently hunting, and hunting in earnest, that we gave up everything else to follow her. The ground was covered, more or less thickly, with patches of purslane, and it was under these weeds that our *Ammophila* was eagerly searching for her prey. After thoroughly investigating one

plant she would pass to another, running three or four steps and then bounding as though she were made of thistledown and were too light to remain upon the ground. We followed her easily, and as she was in full view nearly all of the time, we had every hope of witnessing the capture, but in this we were destined to disappointment. We had been in attendance on her for about a quarter of an hour, when, after disappearing for a few moments under the thick purslane leaves, she came out with a green caterpillar. We had missed the wonderful sight of the ^{xy} paralyser at work, but we had no time to bemoan our loss, for she was making off at so rapid a pace that we were well occupied in keeping up with her. She hurried along with the same motion as before, unembarrassed by the weight of her victim. Twice she dropped it and circled over it a moment

before taking it again. For sixty feet she kept to open ground, passing between two rows of bushes, but at the end of this division of the garden, she plunged, very much to our dismay, into a field of standing corn. Here we had great difficulty in following her, since, far from keeping to her former orderly course, she zigzagged among the plants in the most bewildering fashion, although keeping a general direction of northeast. It seemed quite impossible that she could know where she was going. The corn rose to a height of six feet all around us; the ground was uniform in appearance, and, to our eyes, each group of corn-stalks was just like every other group; and yet, without pause or hesitation, the little creature passed quickly along, as we might through the familiar streets of our native town.

“At last she paused and laid the burden down. Ah! the power that has led her is not a blind, mechanically perfect instinct,

for she has travelled a little too far. She must go back one row into the open space that she has already crossed, although not just at this point. Nothing like a nest is visible to us. The surface of the ground looks all alike, and it is with exclamations of wonder that we see our little guide lift two pellets of earth which have served as a covering to a small opening running down into the ground.

“The way being thus prepared, she hurries back with her wings quivering and her whole manner betokening joyful triumph at the completion of her task.

We, in the meantime, have become as much excited over the matter as she is herself. She picks up the caterpillar, brings it to the mouth of the burrow and lays it down. Then, backing in herself, she catches it in her mandibles and drags it out of sight, leaving us full of admiration and delight.

“How clear and accurate must be the observing powers of these wonderful little creatures! Every patch of ground must, for them, have its own character; a pebble here, a larger stone there, a trifling tuft of grass—these must be their landmarks. And the wonder of it is that their interest in each nest is so temporary. A burrow is dug, provisioned, and closed up, all in two or three days, and then another is made in a new place with everything to learn over again.”

That the wasp actually observes and remembers the surroundings of her nest, those just quoted proved to their cost again and again by disturbing the grass or weeds near the nest in order to see more easily, when the wasp kept them waiting endless minutes while she searched blindly about, evidently puzzled by the changes.

The wasps also noticed at once strange objects, as pebbles or seed-pods put near

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their nests, and one abandoned her burrow because lines had been drawn in the sand near it.

Mr. Bates tells the following story of the wasps at Santarem, illustrating their wonderful ability to find their way back to their burrows, —

“While resting in the shade during the great heat of the early hours of afternoon, I used to find amusement in watching the proceedings of the sand-wasps. A small pale-green kind of *Bembex* was plentiful near the Bay of Mapiri. When they are at work, a number of little jets of sand are seen shooting over the surface of the sloping bank. The little miners excavate with their fore-feet, which are strongly built and furnished with a fringe of stiff bristles; they work with wonderful rapidity, and the sand thrown out beneath their bodies issues in continuous streams. They are solitary wasps, each female working on her own account.

“After making a gallery two or three inches in length, in a slanting direction from the surface, the owner backs out, and takes a few turns round the orifice, apparently to see whether it is well made, but in reality, I believe, to take note of the locality, that she may find it again. This done, the busy workwoman flies away; but returns, after an absence varying in different cases from a few minutes to an hour or more, with a fly in her grasp, with which she re-enters her mine. On again emerging, the entrance is carefully closed with sand. . . . I have said that the *Bembex* on leaving her mine, took note of the locality; this seemed to be the explanation of the short delay previous to her taking flight; on rising in the air, also, the insects generally flew round over the place before making straight off. Another nearly allied, but much larger species, the *Monedula signata*, whose habits I observed on the banks of the Upper Amazons.

sometimes excavates its mines solitarily, on sand-banks recently laid bare in the middle of the river, and closes the orifice before going in search of prey. In these cases the insect has to make a journey of at least half a mile to procure the kind of fly, the *Motuca*, with which it provisions its cell. I often noticed it to take a few turns in the air round the place before starting; on its return it made, without hesitation, straight for the closed mouth of the mine. I was convinced that the insects noted the bearings of their nests, and the direction they took in flying from them. The proceeding in this and similar cases seems to be a mental act of the same nature as that which takes place in ourselves when recognising a locality. The senses, however, must be immeasurably more keen, and the mental operation much more certain, in them than they are in man; for to my eye there was absolutely no landmark on the even surface of sand which could serve as

guide, and the borders of the forest were not nearer than half a mile. The *Monedula signata* is a good friend to travellers in those parts of the Amazons which are infested with the bloodthirsty *Motúca*. I first noticed its habit of preying on this fly one day when we landed to make our fire and dine, on the borders of the forest adjoining a sand-bank. The insect is as large as a hornet, and has a most waspish appearance.

“I was rather startled when one out of the flock which was hovering about us flew straight at my face; it had espied a *Motúca* on my neck, and was thus pouncing upon it. It seizes the fly, not with its mandibles, but with its fore and middle feet, and carries it off tightly held to its breast. Wherever the traveller lands in the Upper Amazons in the neighbourhood of a sand-bank, he is sure to be attended by one or more of these useful vermin-killers.”

The solitary wasps, having to search out a new place for each cell, and being also obliged oftentimes to go far for their prey, find it necessary to exercise both observation and memory, and that is doubtless the reason they have become so very skilful in finding their way to a given spot. Each nest made presents a new problem, and as long as the wasp has to solve these problems by its own unaided skill there is little danger of its degenerating into a mere mechanical worker. The enforced exercise of its faculties doubtless has been the means of developing them, and will be the means of continuing their development.

The intelligence of the sand-wasps in closing their burrows when they leave them is certainly of a high order.

Ammophila stores her caterpillars in a pocket at the end of her rather short tunnel, and when she leaves her nest she is

generally careful to close the entrance with little pellets of earth, which of course she has to remove every time she enters. Some species of *Ammophila* store away several small caterpillars in one nest, and at least some of them always temporarily close the nest before leaving it. Individual wasps differ in their manner of making and closing the nest, some being very particular to see that all is well done, and others extremely careless, doing their work so badly that the contents of the nest are scarcely covered from sight.

“Of two wasps that we saw close their nests on the same day, one wedged two or three pellets into the top of the hole, kicked in a little dust, and then smoothed the surface over, finishing it all within five minutes. This one seemed possessed by a spirit of hurry and bustle, and did not believe in spending time on non-essentials. The other, on the contrary, was an artist, an idealist. She worked for

an hour, first filling the neck of the burrow with fine earth, which was jammed down with much energy, this part of the work being accompanied by a loud and cheerful humming, and next arranging the surface of the ground with scrupulous care, and sweeping every particle of dust to a distance. Even then she was not satisfied, but went scampering around hunting for some fitting object to crown the whole. First she tried to drag a withered leaf to the spot, but the long stem stuck in the ground and embarrassed her. Relinquishing this she ran along a branch of the plant under which she was working, and, leaning over, picked up from the ground below a good-sized stone, but the effort was too much for her and she turned a somersault on to the ground. She then started to bring a large lump of earth, but this evidently did not come up to her ideal, for she dropped it after a moment, and seizing another dry leaf, carried it success-

fully to the spot, and placed it directly over the nest."

One of the most remarkable performances ever recorded of a wasp, is described by the same observers, thus, —

"Just here must be told the story of one little wasp whose individuality stands out in our minds more distinctly than that of any others. We remember her as the most fastidious and perfect little worker of the whole season, so nice was she in her adaptation of means to ends, so busy and contented in her labour of love, and so pretty in her pride over her completed work. In filling up her nest she put her head down into it, and bit away the loose earth from the sides, letting it fall to the bottom of the burrow, and then, after a quantity had accumulated, jammed it down with her head. Earth was then brought from the outside and pressed in, and then more was bitten from the sides. When, at last, the filling was level with the ground,

she brought a quantity of fine grains of dirt to the spot, and picking up a small pebble in her mandibles, used it as a hammer in pounding them down with rapid strokes, thus making this spot as hard and firm as the surrounding surface. Before we could recover from our astonishment at this performance, she had dropped her stone and was bringing more earth.

We then threw ourselves down on the ground that not a motion might be lost, and in a moment we saw —

her pick up the pebble, and again pound the earth into place with it, hammering now here and now there, until all was level. Once more the whole process was repeated, and then the little creature, all unconscious of the commotion that she had aroused in our minds, unconscious, indeed, of our very existence, and intent only on doing her work and doing it well, gave one final comprehensive glance around and flew away."

This remarkable occurrence is not the only one of the kind on record, for in Western Kansas a species of *Ammophila* was observed to use a pebble in the same way to close the opening to her hole. The facts are thus reported, —

“When the excavation had been carried to the required depth, the wasp, after a survey of the premises, flying away, soon returned with a large pebble in its mandibles, which it carefully deposited within the opening; then, standing over the entrance upon her four posterior feet, she (I say she, for it was evident that they were all females) rapidly and most amusingly scraped the dust with her two front feet, ‘hand over hand,’ back beneath her, till she had filled the hole above the stone to the top. The operation so far was remarkable enough, but the next procedure was more so. When she had heaped up the dirt to her satisfaction, she again flew away, and immediately returned with a

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smaller pebble, perhaps an eighth of an inch in diameter, and then, standing more nearly erect, with the front feet folded beneath her, she pressed down the dust all over and about the opening, smoothing off the surface, and accompanying the action with a peculiar rasping sound. After all this was done, and she spent several minutes each time in thus stamping the earth, so that only a keen eye could detect any abrasion of the surface, she laid aside the little pebble and flew away, to be gone some minutes.

“Upon her return she bore a large green larva, and laying it down near the door, she opened her carefully closed burrow, dragged in her prize and sealed it up as carefully as before, again using the little pebble to pound down the surface. This laborious operation was repeated several times until the requisite number of larvæ had been stored. Once the observer varied the routine by taking away the little peb-

ble that closed the door, while the wasp was in her hole. Returning, she looked about for her door, but not finding it, apparently mistrusted the honesty of a neighbour, which had just descended, leaving her own door temptingly near. She purloined this pebble and was making off with it, when the rightful owner appeared and gave chase, compelling her to relinquish it."

There is another very remarkable story of an *Ammophila*, told by Mr. Theodore Pergande to the Entomological Society of Washington. While on a gravelly slope Mr. Pergande noticed a female sand-wasp, belonging to the genus *Ammophila*, flying about in a peculiar fashion. Presently it alighted and ran briskly about in every direction, with the head close to the ground and the abdomen elevated, while the antennæ were in constant agitation, as if searching for something important, though nothing in any-way striking to the eye

could be seen on the bare sand which could have attracted its attention. Suddenly it stopped at a certain spot, pressed the head close to the ground, and commenced beating the ground with its abdomen, producing at the same time a quite sharp sound similar to *bss, bss, bss*, tapping with each sound the earth with its abdomen. It continued this performance for some time, running or flying off a short distance twice or thrice during brief intervals. Finally it picked up with its jaws "a small pebble, carried it to the mysterious spot, and deposited it on top, pressing the pebble down as much as possible to insure its remaining in position. Running then again a distance away, it picked up another pebble and placed it close to the first one; after a while a third was added. No more pebbles of the desired size being near enough at hand, it ran some distance

farther, when it came across a pebble which appeared to suit its purpose; took hold and lifted it, but unfortunately the shape of this little stone was such that it slipped from its jaws. It tried again and again for quite a while to obtain a good hold, though without success, when it left it in apparent disgust. Running about after this failure for some time, in search of a more suitable stone, but not finding what was wanted, she returned to her little monument of pebbles and commenced to rearrange them and press them down as much as possible. After being satisfied that everything was well done, she flew away, not to return."

After she had gone Mr. Pergande removed the little stones and dug out her caterpillar, with the egg attached.

Evidently this wasp had found the exact location of her nest by listening to the sounds made by striking

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the abdomen against the ground and buzzing at the same moment.

The *Ammophila* finds in paralysing her caterpillars a more difficult problem than faces those wasps that use the adult insect as provision for their young. A well-directed sting in the central nerve-ganglion of an adult insect is enough to paralyse, or even to kill it, but the caterpillar, being a larva and composed of a number of segments, each with its own nerve centre, requires more heroic treatment, and this, *Ammophila* well knows. She catches her caterpillar and stings it, not once, but several times, each time in or near a different nerve-centre. Her performance in poisoning her prey has been thus described by an eye-witness, —

“Standing high on her long legs and disregarding the continued struggles of her victim, she lifted it from the ground, curved the end of her abdomen under its body, and darted her sting between the

third and fourth segments. From this instant there was a complete cessation of movement on the part of the unfortunate caterpillar. Limp and helpless, it could

offer no further opposition to the will of its conqueror.

For some moments the wasp remained motionless, and then, withdrawing her sting, she plunged it successively between the third and the second, and between the second and the first segments.

“The caterpillar was now left lying on the ground. For a moment the wasp circled above it and then seized it again, further back this time, and with great deliberation and nicety of action gave it four more stings, beginning between the ninth and tenth segments and progressing backward.”

This order of proceeding is not by any means invariable with the wasps; some sting but two or three times; some sting

nearly all the segments. The number of stings applied and the order in which they are given depend upon the individual wasp. They all understand in a general way the advisability of stinging a caterpillar more than once, but beyond this they exercise their own judgment.

While the miners generally live quite apart from each other, some species congregate together in colonies, as do certain species of the solitary bees; where this is the case it is quite an experience to come upon the broad, bare spot usually selected by these fierce-looking settlers. Each wasp has her own hole, which she locates accurately and finds immediately after an absence; she does not stumble into her neighbour's nursery, and probably would meet a very bad reception if she did. These wasps must possess quite enviable powers of observation, as well as very reliable memories, to enable them to

come flying rapidly from a distance and drop upon just the right spot in a bank where, to the human eye, there is nothing to mark the place, and where all about are other concealed burrows of neighbours, ready to pounce upon the luckless householder who should make a mistake and attempt to open the wrong door. Although the wasps live thus in settlements, they are no more free from petty disagreements with their neighbours than are much larger and supposedly wiser creatures.

Sometimes they quarrel, and apparently for the mere sake of quarrelling, very likely finding in this interesting pastime an outlet for overflowing wasp spirits. Sometimes they do more than quarrel; they are mean enough to steal one another's provisions when hunting is poor; and when one returns with a prize, several will give chase and try to relieve her of her burden.

Certain of the fossorial wasps, when they bring prey to the burrow, first enter

to see that all is as they left it, leaving the captured insect near the entrance. If the result of their examination is favourable, out comes the wasp and drags in the insect. Once a French naturalist removed the cricket one of these wasps had captured and placed close to the entrance to her hole while she went in to reconnoitre.

It was placed several inches away, but was shortly found by the wasp and dragged back to the hole. Again her ladyship went in to reconnoitre and again the cricket was taken away. It was found as before and dragged

back, while the wasp, true to her habit, went in the hole and left it at the entrance. The same thing was repeated over forty times, until the patience of the experimenter gave out ; and one can imagine the nervous condition of the wasp at this unaccountable and persistent interference with a matter that from her point of view

was nobody's business but her own. Had it occurred to Madam to look for troublesome intruders outside the hole instead of inside, she would have saved herself a great deal of time and strength.

That wasps may exercise ingenuity in capturing their prey is proved by the following story.

A wasp was once seen to alight within an inch or two of a spider's nest on the side opposite the opening.

“Creeping noiselessly around towards the entrance of the nest, the wasp stopped a little short of it and for a moment remained perfectly quiet, then reaching out one of his antennæ he wriggled it before the opening and withdrew it. This overture had the desired effect, for the boss of the nest, as large a spider as one ordinarily sees, came out to see what was wrong and to set it to rights. No sooner had the spider emerged to that point at which he was at the worst disadvantage, than the

wasp, with a quick movement, thrust his sting into the body of his foe, killing him easily and almost instantly. The experiment was repeated on the part of the wasp, and when there was no response from the inside, he became satisfied, probably, that he held the fort.

“At all events he proceeded to enter the nest and slaughter the young spiders, which were afterwards lugged off one at a time.”

Another wasp tried a similar experiment on a caterpillar rolled in a leaf. The wasp examined both ends of the rolled leaf only to find them closed. It then clipped a hole in one end. Having done this, it went to the other end and made a noise which frightened the caterpillar and caused it to rush out of the hole the wasp had cut. Of course the wise wasp seized the foolish caterpillar, stung it, and attempted to carry it home. Finding it too large, her waspship cut it in two, carried away one half, and came back for the rest.

Another wasp was once watched trailing a spider that tried to escape by running into a room and hiding. When the quarry disappeared the wasp ran in narrowing circles like a hound, and when it struck the scent it followed all the turns the spider had made, just as a dog would have done.

The wasp finally captured the spider, and tucking it up under its long hind-legs, just as a hawk carries off its quarry, flew away with it.

A few species of wasps catch their prey first and then dig the burrow. Among these is a pretty little black and white creature that rears her progeny upon spiders. She catches her spider and to save it from the ants that are always lurking about, she sometimes hangs it up in a plant while she digs her burrow. She does not always do this, and whether this very intelligent act depends upon the prevalence of ants in

the neighbourhood, acting upon a superior intellectual development of the individual wasp that does it, who shall say?

One of these wasps once dug her nest and caught her spider—a large one, which she dragged near her burrow.

“Presently she went to look at her nest and seemed to be struck with a thought that had already occurred to us,—that it was decidedly too small to hold the spider. Back she went for another survey of her bulky victim, measured it with her eye, without touching it, drew her conclusions, and at once returned to the nest and began to make it larger. We had several times seen wasps enlarge their holes when a trial had demonstrated that the spider would not go in, but this seemed a remarkably intelligent use of the comparative faculty. . . . While she was thus employed, the spider was

attacked by a very tiny red ant, that could not by any possibility have stirred it. When the wasp caught sight of this insignificant marauder she fell into a fit of wild fury, and bending her abdomen under, seized the ant again and again in her mandibles, and flung it backward against the tip of her sting. The little creature finally escaped, seeming none the worse for the rough handling to which it had been subjected, while the wasp, still trembling with excitement, grasped her spider and rushed off to a distance of several feet, carrying it up on a weed and depositing it there. The labour of excavation was then resumed, and after half an hour's work, was completed to her satisfaction. Coming up head first, she flattened herself out on the ground, and sprawling thus, dragged herself all around it. The spider was now brought to the nest, being left once on the way, while she ran in and out again, and was taken in after a new and

original fashion. Backing in herself, she seized it by the tip of the abdomen¹ and dragged it down without any trouble, since the legs were gently pushed up over the head and made no resistance.

“In two minutes she emerged from the opening, and standing on the four posterior legs, with her abdomen hanging down into the hole, scratched the earth backward with the front legs and mandibles. As it fell in she pushed it down with the abdomen, and as the hole filled she raised herself higher and higher on her legs, still using the tip of the abdomen to work the material into place.”

The underground nests of the digger-wasps differ in form according to the species, and somewhat according to the individual. They all make a burrow, however, ending in some sort of little compartment, where the insects used as food can be stored. Many of them store but

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¹ Wasps generally drag their victims down head first.

one large insect in a burrow. Many others store a number of smaller insects, for the nourishment of each larva. A few build little pockets or rooms from the side of the main burrow, thus constructing a house of several rooms, instead of making a separate burrow for each egg laid.

Each species has its favourite insect, some catching spiders, some caterpillars, some beetles, some bugs, some aphides, and so on.

Some species prefer bees, catching two dozen or more wild bees to store one nest; and there are wasps in the world that prefer honey-bees to anything else, these sometimes causing havoc among the hives.

While some wasps sting their prey to paralysis, others injure the captured insects very little, and still others sting them to death. Some, again, do not sting the insect at all, but bite it until it is quiet, often squeezing the neck with the mandibles

without otherwise injuring the insect. The object of stinging seems to have been, in the beginning, to render the insect quiet, and from this starting-point we find all degrees of completeness in paralysing the food among the different species.

While most of the earth-boring species provision the nest once for all and close it up, we find some that put in only what food the larva requires at the time, and from day to day open the nest and replenish the store. These care for the young after the manner of the social wasps, but without the conveniences of the communal society composed largely of workers. They seem to exist in an intermediate stage between the social wasps and the perfected diggers.

The fossorial wasps, having no home to which to retire, as the paper-makers have, are possessed of a more roving disposition, and are particularly fond of flying about in the warm sunshine. Many of them have

long tongues, similar in structure to the tongue of the hornet, but with all the parts so elongated that the wasp can reach almost as far as a honey-bee into a flower cup.

They hide away at night and during stormy weather in sheltered crevices, and some of them dig holes in the ground, not for the benefit of their progeny, but

to provide a lodging for themselves. In some instances the little male builds himself a tunnel, into which to retire when he wishes to rest.

When the boneset is in bloom in late summer, numbers of the large wasps may be seen at work among its white heads.

But it is when the goldenrod comes into blossom that the wasp collector and the wasp observer find their veritable land of delight. All sorts of bees and wasps flock to the goldenrods, as do

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also the butterflies, which seem to take a mischievous delight in tormenting the wasps.

Time and again when a wasp rises from a flower a butterfly will also rise and flutter its wings about the distracted wasp, which tries to dodge this way and that to escape its tormentor.

One can almost see the wasp get out of temper, and the frivolous butterfly laugh at it. But getting out of temper with a butterfly is wasted energy; the broad, thin wings are unstingable; and indeed the wasp does not try to sting, but only to dodge away from the mischievous and no doubt heartily despised trifler.

The butterfly can have no possible object in interfering with the wasp other than the mere fun of it, and one is glad to discover that butterflies possess, like ourselves, a sense of humour.

In watching wasps one cannot fail to make the intimate acquaintance of many

other tribes of insects, and the dramas, absurd or tragic, always enacting in the air about us or on the ground under our feet, must be witnessed to be appreciated.

Insects, like other animals, seem not to be devoid of curiosity. One day a small green katydid intently observing the sand coming out of a hole where a small black *Sphex* was digging away for dear life, went and looked in when the wasp retired with a load of earth, upon which the wasp became greatly excited and fell upon that katydid and chased him away. Once more the too curious katydid walked toward the hole, but he did not look in this time, for the wasp, with quivering wings and angry buzzing, ran after him and he scampered off not to return, evidently concluding that discretion was preferable to gratified curiosity under the circumstances.

Many of the fossorial wasps are very suspicious, and it requires patience to get near enough to watch one at its work of nectar-gathering. It cocks its head on one side, glances at the intruder, and in a flash is off.

Sometimes, however, the large wasps resent intrusion, as one once did on the edge of a meadow. It was sitting on a willow leaf and did not care to be disturbed. Instead of flying away it reared itself up on its tail, opened its jaws and apparently invited its visitor to "touch me if you dare." Its visitor did not dare, having no net along; and probably nobody would have enjoyed interfering with an enormous black wasp that reared up on end and looked as that one did.

Wasps dig many holes, but finish few. They seem to have very strict ideas as to what a burrow should be, and often start

half a dozen before the earth is just right to their critical judgment.

One watching the many fruitless attempts of the countless numbers of wasps winging their way over the earth in the latter part of the summer cannot but imagine the value of these little earth-openers to the soil. Their countless unfinished burrows in the hard earth, as well as their finished ones, let in air and water; the water settles to still deeper parts, and later freezing breaks up the hardened soil to an extent out of all proportion to the work of the little digger. No doubt to the wasp we owe in part the fertility of the face of the earth.

Although at times such hard workers, wasps appear to waste a great deal of time fussing about.

Small black *Sphex* wasps were often watched flying along the carriage road up and down, up and down, alighting every moment and running along as though they

had lost something they needed very badly but could not find.

They were doubtless looking for places suitable to dig in, but to the observer

ignorant of the nicer distinctions of wasp problems, they seemed to be very light-headed and to be wasting a great deal of time. When one had begun to dig its hole it was easily frightened away by a passer-by, and when it returned employed somewhat the tactics of the partridge when trying to conceal its young. It did not go straight to its hole, but ran a long way past it on one side and then on the other and hunted about as if it had never started a hole in the world. Then, all at once, perhaps believing it had thrown any possible observer quite off the track, it popped

into its hole and went to work vigorously continuing the excavation.

There are some species of the digger-wasps that make their excavations in bricks or in sand-banks that are almost as hard as stone. These little miners are as careful as the wood-borers not to leave chips lying about to betray their presence to the enemy. They dig out the hard brick or sand with their jaws, moistening and softening it with liquid from their mouths, and as soon as they have chiselled out a fragment they fly to some distance and drop it. They do not go in very far, usually not more than two inches. Sometimes they line with clay the cave they have excavated, and stop the opening also with clay.

There is a little miner-wasp in Europe that uses the material it removes from its burrow in a hard sand-bank to make a round tower over its hole. The French naturalist Réaumur watched these wasps at work

easily cutting into a sand-bank that was almost as hard as stone. Having detached a few grains of sand, the wasp kneads it into a pellet with liquid from its mouth, and this pellet is attached at the mouth of the excavation. The wasp forms another pellet, adds it to the first, and continues in this way until it has constructed a little chimney or tower over its hole. The tower is not a good piece of masonry, however, as the pellets are not carefully joined, but openings are often left between them. Although the tower at first is built perpendicular to the wall upon which it rests, at the outer end it is curved to correspond to the curve of the insect's body. This makes the tower easy of entrance to the rightful occupant, but would exclude a larger enemy. When the little nest is finished, provisioned, occupied, and sealed, the tower, which it seems was only a temporary structure is taken down as expeditiously as it was put up.

There have been various guesses as to why this tower is built by the wasp (*Odynerus murarius*). Is it to protect the young larva from the heat of the sun? Is it to keep out the parasitic flies that naturally would be discouraged from entering into any such deep, dangerous tunnel?

Man may question, but *Odynerus* does not reply. While he speculates upon her object in doing so she continues to build her mysterious towers before his eyes quite indifferent to his presence or his curiosity.

One sometimes sees a brilliant scarlet and black insect, wingless, ant-like in form, but clothed with a thick velvety coat, hastening along a path or a roadside.

One's first impulse is to catch it, but second thoughts in this case are decidedly the best; for this gorgeous "velvet ant," as it is called, is not an ant at all, but a wasp. Although it is so unwasp-like as to have no wings, it retains its sting without diminu-

tion, as whoever attempts to pick it up will quickly discover. The males are winged and are sometimes seen about flowers, but the females have given up the vanity of wings and remain on the earth, where they can run very fast and where they dig burrows and store up insects for their progeny. There are a great many species of the velvet ant, and some of them are found in the nests of bumble-bees and of other wasps. The Texans call the velvet ant the Cow-killer ant, and believe that its sting is dangerous to cattle.

Most of the solitary wasps are remarkable for their unflagging industry. Each excavation in brick or wood or earth may take several days to complete; it must then be provisioned and sealed, and no sooner is this done than the faithful little mother begins another. Half a dozen or more of these cradle-cells, with provisions and infant wasp occupants, testify to her industry.

Late in the season, however, the wasps have a grand rally, an enormous picnic, where the chief occupations are sitting in the sun, drinking nectar from the autumn flowers, flying swiftly about in the noon-day heat, and getting into the houses, to the consternation of the human occupants, who, though much larger and stronger than wasps, are nevertheless very much afraid of them.

Then can they be caught by the score in the skilfully wielded net of the insect collector. Big wasps, little wasps, black, red, yellow, blue, white, all colours, shapes, and sizes, they may be gathered in. Then, too, the young male wasps are as abundant as the females, both frequenting the goldenrods when the sun is bright.

They have their good time drinking nectar and eating insects if they feel so inclined. Then, too, come the yellow-

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jackets and hornets to swell the numbers.

That wasps are capable of enjoying themselves, no one can doubt who has watched them at this time of year.

Once a hornet was watched in holiday mood, eating a fly while hanging by one foot to a twig.

“The half-eaten fly was held by the front feet, while the other legs and the wings stuck out carelessly in all directions. As the mandibles or jaws and the antennæ kept in rapid motion, and the fly was turned over and over by the fore-feet, the wasp swung slowly back and forth with the same appearance of enjoyment and comfort as a man eating an apple in a hammock.”

Nor has the solitary wasp been wholly neglected by the ancients; with them it too had its use, for Moffett says, —

“Pliny greatly commendeth the solitary Wasp to be very effectual against a Quar-

tain Ague, if you catch her with your left hand, and tie or fasten her to any part of your body (always provided that it must be the first Wasp that you lay hold on that year).”

There are a number of curious and interesting little creatures called gall-wasps, which belong to the Order Hymenoptera, but not to the wasp division.

The so-called Fig-wasp with its remarkable habit of fertilising figs, is not a wasp, but belongs rather among the gall-insects, which are boring, instead of stinging, Hymenoptera.

No doubt the solitary wasps play their part in fertilising the flowers, and are valued and necessary agents.

It should not be forgotten that the wasps, through their habit of using insects to feed their young, are exceedingly valuable to the agriculturist. From a single nest have been taken several dozens of canker worms, and even where but few

insects are stored in a burrow, the immense number of wasps using them acts as a check to the insect pests. Aphides, caterpillars, beetles, bugs, numberless destructive creatures are laid to rest in the nests of the wasps.

The wasp has its place in the scheme of the world, and but for it the hordes of insects destructive to vegetation might lay waste the gardens of the earth, even to the discomfiture of proud man himself.

Then all honour to the little wasps, whose influence in human society may in its own sphere be as important and as far-reaching as that of more powerful-seeming forces.

All honour to the little wasps, who, a link in the endless chain of living things, are doing their work and helping to make possible that higher civilisation which man fondly believes belongs to himself alone.

NEST CUT IN TWO LENGTHWISE

A P P E N D I X

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25. "Vespa the wasp is an angrie creature."
"Speculum Mundi," 1643. — John Swan.
25. The Ettrick Shepherd. "Noctes Ambrosianæ."
— Christopher North.
28. Pastor Müller. "Once a Week," July 9,
1870. "Natural History of Wasps."
Pastor Müller. "Beiträge zur Naturgeschichte
der grossen Hornissen." "Magazin der Ento-
mologie." — Germar. Halle, 1817. Band iii.
36. "Wasps quickly distinguish colors." "Some
Observations on the Special Senses of Wasps."
"Proceed. of the Nat. Hist. Soc. of Wiscon-
sin," April, 1887. — George W. and Elizabeth
G. Peckham.
42. Wasps make honey. "Introduction to Ento-
mology." — Kirby and Spence.
- '43. "The naturalist August Saint-Hilaire." "The
Insect World." — Louis Figuier.
59. The apple full of wasps. "Animal Intelli-
gence." — Geo. J. Romanes.

61. Butcher clipping wings. "Nat. Hist. of Wasps."
"British Social Wasps." — Edward Latham Ormerod, M.D.
62. Wasps catching flies on cows. "The Zoölogist."
London, Oct. 15, 1896. "Wasps and their
Uses."
64. English estate infested by wasps. "Nat. Hist.
of Wasps." — Ormerod.
79. The Iliad, Bk. xii. Bryant's trans.
80. Virgil. Georgic iv.
80. Ovid. Fasti, Lib. iii.
81. "Moreover, the Lord thy God." — Deuteron-
omy vii. 20.
81. "And I will send hornets." — Exodus xxiii. 28.
"And I sent the hornet." — Joshua xxiv. 12.
83. "Eight miles from Grandie." "Curious History
of Insects." — Frank Cowan. From second
volume of Lieutenant Holman's "Travels."
86. Engineers on banks of Jumna. "Once a Week,"
July 9, 1870. "Natural History of Wasps."
86. Shahjehanpoor. "From Cadet to Colonel." —
Sir Thomas Seaton, K. C. B., 1877.
87. Dr. King of Penang. "Natural History of
Wasps." — Ormerod.
88. "A picket of Lord Clyde's army." "From
Cadet to Colonel." — Sir Thomas Seaton.

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101. Wasps generated from crocodile. "Theatre of Insects." — Moffett.
  104. Migration to bottom of cell. "Natural History of Wasps." — Ormerod.
  110. Müller — 5 days as egg, 9 days as larva, 13 days as pupa. Owen — 8 days as egg, 12–14 days as larva, 10 days as pupa.
  - 137–139. South American Nests. "Études sur la Famille des Vespides." "Monographie des Guêpes Sociales." — Henri de Saussure.
  137. Mud nest of India. "Natural History of Wasps." — Ormerod.
  138. Mocking-birds. "Natural History of Wasps" — Ormerod.
  139. The fly-catcher. "The Naturalist in Nicaragua." — Thomas Belt.
  139. South American Nests. — Saussure.
  154. "The Creoles of Mauritius," Backhouse's "Mauritius." — From Cowan.
  158. Wasps in Natal. "Animal Intelligence." — George J. Romanes.
  160. Edward Topsell. "History of Four-footed Beasts and Serpents" (bound in large vol. with Moffett).
  161. Story of frog-hoppers. "The Naturalist in Nicaragua." — Thomas Belt.

166. Cures for stings. "Theatre of Insects." — Moffett.
167. Allen's wife. "Theatre of Insects." — Moffett.
168. Emperor Vespasian. "The History of Our Lord as Exemplified in works of Art." — Mrs. Jameson.
169. Wasps' nests burned for asthma and colds ; a practice still recommended and employed by the negroes of the Southern United States
171. "An infinite number of wasps." "Curious History of Insects." — Frank Cowan.
171. "If hornets build low." Ibid.
172. Gamekeeper's observations. "Natural History of Wasps." — Ormerod.
172. Storms at sea : flying at evening. — Topsell.
173. Superstitions. — Frank Cowan.
182. Sir John Lubbock. "Ants, Bees, and Wasps.'
184. "A specimen of *Polistes carnifex*." "The Naturalist on the River Amazons." — Henry Walter Bates.
187. Three-story nest of Java wasp. — Saussure.
216. White plaster nests. "On the Instincts and Habits of the Solitary Wasps." "The mud-daubers." — Geo. W. and Elizabeth G. Peckham.
219. Chinese superstitions. "Curious History of Insects." — Frank Cowan.

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243. Trypoxylon in the straw-stack. "Instincts and Habits of the Solitary Wasps." "The Wood-borers." — G. W. and E. G. Peckham.
248. Crabro stirpicola. Ibid. "The Toilers of the Night."
261. "We had not supposed." Ibid. "The Great Golden Digger."
263. Wasp puzzled by removal of leaf. Ibid. "Two Spider Hunters."
269. "The Naturalist on the River Amazons." "At Santarem." — Henry Walter Bates.
274. "Of two wasps." Instincts and Habits of the Solitary Wasps." — G. W. and E. G. Peckham. "Ammophila and her Caterpillars."
278. "When the excavation." Ibid. Quoted from "Habits of Ammophila." — S. W. Williston, Lawrence, Kas.
280. Mr. Pergande's story. "Life History of American Insects." — Clarence Moores Weed.
283. "Standing high on her long legs." "Instincts and Habits of the Solitary Wasps." "Ammophila and Her Caterpillars." — G. W. and E. G. Peckham.
287. Cricket taken from wasp. — Ibid. Experiment made by M. Fabre.
288. "Creeping noiselessly." "Animal Intelligence." — G. J. Romanes.
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289. Caterpillar in rolled leaf. — Mr. R. S. Newall, F. R. S. "Nature." Vol. xxi., p. 494.
290. Wasp trailing spider. — Mr. Henry Cecil. "Nature." Vol. xviii., p. 311.
290. Wasp hanging up its spider. "Instincts and Habits of the Solitary Wasps." "The Spider Ravishers." — G. W. and E. G. Peckham. The pictures of suspended spiders are also taken from this chapter.
291. "Presently she went to look." — Ibid.
292. "And sprawling thus." Wasps had been noticed before by the same observers acting in this peculiar manner, after finishing a nest or capturing prey, and it raised the question as to whether this might be their method of expressing pleasurable emotions.
303. The round tower. "Insect Architecture." — J. Rennie. "The Library of Entertaining Knowledge," Boston, 1830. Reported of Réaumur.
307. Hornet hanging by one leg and eating fly. "Life History of American Insects." — Clarence Moores Weed.