

the paper manufactured by these subterranean species, while amply good enough for the protected situation, is but a poor coarse material compared to the strong flexible product of the kinds that suspend their familiar silver-grey nests in trees. Of the seven or eight species of *Vespa* occurring in the Ottawa district, the commonest bears the sinister name of *Vespa diabolica*; but our largest sized representative of the genus, found right across the continent from Nova Scotia to British Columbia, is *Vespa maculata*, popularly known as the bald-faced hornet, and it may be taken as typical of the most accomplished paper-makers.

V. maculata, which is heavy-bodied for a wasp, wears the traditional wasp livery of buff and black, and owes its popular name to the pale yellow markings on its face. As is usually the case among the social Hymenoptera, the males are larger than the workers, and the queens are larger than the males. The bald-face hornet's chief mental characteristics are a very short temper and an extreme intolerance of strangers near its nest; and it is armed with a powerful sting as many people can feelingly testify. Indeed, a friend who sometimes bears me company on biological expeditions, and who is not at all of a timid disposition, suffers from what may be termed "wasp-shock". Some years ago he incautiously sat down near a hornet's nest, and was severely stung. And now, so far from assisting in the observation of *Vespa* economy, the very sight of a nest causes him—in the German war-office term—to retire promptly to a prepared position in the rear. Contrasted with the complicated activities of the honey bee or the still more marvellous organization of the ant societies, the life history of a colony of *V. maculata* is comparatively simple. It is rather doubtfully stated that males and workers may sometimes hibernate in the nest, but in general it appears to be only the young fertilized queens that live over winter, sheltering under bark or in rotten logs. On several occasions in the early spring, I have found torpid queens in such situations, but so exposed to the winter cold, that it was a mystery to me how they had survived. Many of the invertebrates—and some of the lower vertebrates too—are extraordinarily resistant to cold. A degree of frost that would be absolutely fatal to a mammal, has no more effect on some insects than to render them temporarily torpid, and on the first rise in temperature, they are as active as ever.

Emerging from her winter quarters with the first fine weather of spring, each queen sets to work to found a colony. She seeks a sound but weather-beaten surface of wood, and working backwards in the direction of the grain, with her strong jaws she gnaws off the outside fibres along a narrow strip,

leaving the brighter colored wood exposed beneath. The cedar logs that form the verandah posts of a log-cabin on the shore of the Ottawa at Marshall's Bay, are much frequented by wasps for wood pulp, and some parts of the posts are fairly striped with the numerous tiny furrows left by the workers gathering their supplies. The fibres obtained, she chews them into a paste with a viscid secretion from her salivary glands, and with this material she shapes a tiny globular nest about $1\frac{1}{2}$ inches in diameter, consisting of a couple of layers of paper, enclosing a single horizontal comb of eight or ten cells, opening downward. The nest is often attached to the eaves of a building, but usually it is hung from the branches of a tree at some height from the ground. The favorite habitat appears to be a swamp, possibly because there is less disturbance there from passersby; although no passerby with the slightest knowledge of the habits of *V. maculata* is ever anxious to raise any disturbance with them. The paper is somewhat open in texture, but is remarkably strong and flexible and is quite waterproof. The sheets are formed by the accretion of tiny ribbons of pulp, as can easily be traced in the variegated structure. Some *Vespa*s are said to strengthen their paper with herbaceous filaments gathered from growing plants, but I cannot say that I ever observed this myself. The comb material is much thicker and stiffer than the casing paper, and resembles a rather soft cardboard. The light grey color of the paper blends well with the general tone of the bark, and consequently the nest is not a very conspicuous object in the branches.

When her nest is ready, in each cell of the comb the queen lays an egg which hatches out in a few days. Then for a couple of weeks the devoted mother works early and late to feed her unattractive young grubs—first with regurgitated flower nectar, and later with masticated parts of caterpillars—until they transform into pupæ. The pupal stage is short, and the perfect insects soon emerge. The first broods consist entirely of workers, the queens and males not appearing until towards the end of the season. The young wasps begin work immediately. The beauty of instinct is that it is instinctive. The young workers need no domestic science course to teach them their duties in the nest, but take over the management at once, and the queen, relieved of all housekeeping responsibility, has nothing to do but lay eggs.

The workers, whose numbers are constantly increased by the advent of new broods, now busily forage for supplies and feed the larvæ. And to accommodate the rapidly growing family, they keep tearing away the paper casing inside the nest and adding larger sheets outside. The combs, too, are