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Richard T. How

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PSYCHE. V//.

THE HABITS OF THE ACULEATE HYMENOPTERA.—I.

BY WILLIAM H. ASHMEAD, WASHINGTON, D. C.

[Annual address of the retiring president of the Cambridge Entomological Club, 12 January, 1894.]a

The subject of my address is one that has been rarely touched by American entomologists, although offering one of the most attractive and richest fields for research and discovery, as connected with it are many problems of biologic and philosophical importance, which if solved, would throw much light upon many of the mooted questions of the day—evolution of species, development of sexes, specialization of organs, transmission of acquired characters, adaptability to environment, etc.

The first American to publish anything on the subject was John Bartram, who published several articles: the first entitled "An account of some curious wasp-nests made of clay," was published as early as 1745 (Phil. trans., vol. 43, pp. 363-368); the second, "A description of the great black wasp of Penn." (l. c., vol. 46, 1750, pp. 278-280); the third, "On the Yellow wasp of Penn." (l. c., vol. 53, 1763, pp. 57-39).

This last paper is of the deepest interest as it evidently refers to the habits of a *Bembecid*, and the accounts of which, now after over a century and a quarter, have only recently been confirmed, in Europe, by the observations of Fabre and Wesenberg on a similar fossorial wasp, *Bembex rostrata* Fabr.

From John Bartram to our next writer, Benjamin Henry Latrobe, who wrote a paper entitled "Two species of the *Sphex* or wasp found in Virginia and Penn." (Phil. soc., vol. 6, 1809, p. 73) is an unbroken period of nearly half a century. Then we have a period of longer or shorter intervals, with contributions from Thomas Say, Dr. T. W. Harris, F. W. Putnam, Dr. Lincecum, Dr. A. S. Packard, Wm. Couper, Benjamin D. Walsh, Prof. C. V. Riley, E. Baynes Reed, L. O. Howard, Frederick V. Coville, Charles Robertson, C. L. Marlatt, and Dr. A. Davidson.

It is now, I believe, almost universally conceded by all students, who have given any study at all to the aculeate Hymenoptera, that among them are to be found the most specialized, highly developed and intelligent insects. In fact, the marvellous intelligence exhibited by many of the species in this order, in their social habits, the structure of their nests, care of their young, etc., has from time immemorial attracted the attention of man, and in both ancient and modern literature many allusions to them may be found.

It is surprising, therefore, that so many centuries have past and so little

[contains many references to older N.A. lit. on biology of wasps]

Hymenoptera General

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comparatively is known of the vast majority of the most common forms.

It is hoped that a few new facts respecting the habits of some of our species will be found in this address, but it is intended more as a review of the subject, the principal object in view being to bring together what is known of the habits of these insects to show the uniformity of habits in genera and species of the same genus the world over, and, moreover, to point out just how little real knowledge we possess of our own species, with the hope that it may awaken more interest in these insects and kindle a desire in some of our entomologists to make some effort toward unravelling the life history of at least a few of the common species of his neighborhood.

If every entomologist in the United States and Canada would, during the year 1894, make up his mind to at least make known the habits, development and parasites of one or two species it surely could be done, and then what a vast amount of new and interesting reading we should have next winter. How refreshing it would be to take up one of our entomological journals, or an experiment station bulletin, and see some such article in place of the old, old story, "the canker-worm, the codling moth, the chinch-bug, or the plum Curculio."

The subject merits attention also from an economic standpoint, as, with but few exceptions, all the aculeate Hymenoptera are of the greatest economic importance, either as fertilizers of plants, shrubs and trees, by transport-

ing pollen from blossom to blossom, or as destroyers of injurious insects.

In order to bring out more thoroughly the points to which I have called attention, I propose to take up *seriatim* the different families, give a *resumé* of what is known and at the same time incorporate any new facts that may have come under my observation.

Family I. APIDÆ. As the most specialized we may begin, therefore, with this family. Excluding *Apis mellifica* as not indigenous and the *Meliponæ* as not extending into our fauna, we have no less than 35 genera and 520 species belonging to this family. Of these, the genus *Bombus* in structure, social habits, and in the honey-producing qualities of its members, is probably more closely allied to the true honey-bee than any other of our bees and it may, therefore, be considered the forerunner of the honey-bee.

Mr. F. W. Putnam, in "Notes on the habits of some species of humble-bees" (Proc. Essex inst., vol. 4, 1864, pp. 98-104) was one of the first of our writers to treat of some of our species. In this paper he briefly treats of the nesting habits of *Bombus ternarius* Kirby, *B. fervidus* Fabr., *B. vagans* Smith, *B. virginicus* Oliv, *B. separatus* Cr. and *B. pennsylvanicus* De Geer.

The habits of our species agree fairly well with the observations made upon the European species and are briefly as follows: the female bumble- or humble-bee, which has hibernated in some crevice or other secure place during the winter, appears in early spring with the first blossoms from which it can

obtain pollen and almost selects a place in which forming its nest of dry grass in some hollow in the ground more frequently appropriate nests of field mice, open field or under old stumps. Here the female constructs cells of a waxy or plastic material which she deposits her eggs, pollen and honey—the food for the future offspring of her nest—laying her eggs directly in the pollen.

The eggs first laid produce which spin tough cocoons and undergo their transformation into neuters which subsequently form part of the community and of the greatest importance in performing the necessary work of the now rapidly increasing colony. These are followed later, in the fall, by males and fertile females which are, however, smaller than the normal sized individuals. The normal sized males and females reappear again until the fall when they mate and the cycle of their life is completed, the impregnated females of this last brood wander off, hibernating and forming the colonies the following spring.

The number of individuals in a colony is variable; from a dozen to over two hundred individuals have been found in a single nest. Putnam states that a nest of *B. pennsylvanicus* contained sixty-five cells, all of bunches of pollen in

texana Cr., a species also
Jacksonville, Florida.

and parasites of *Xylocopa*
nith, a California species,
described recently in Ent.

4, p. 151, by Dr. Anstru-
son. The nests were dis-
Wilson's Peak, a mountain
et altitude, in June and
92. Mr. Davidson says:—

one piece of wood four inches
nd about three feet long, and as
at one external opening it is
all the cells contained therein
of one bee. From a diagonal
tunnels were driven longitudi-
nce of three or four inches on
parallel to this was another of a
th, and a third very much
cells in all numbering twenty.
not all of one uniform width
in the centre of each cell so
el measures three-eighths of an
ster at the extremities, and half
centre of each cell.

ons are constructed in a manner
entical with those of *X. virgin-*
ibbon-like coil has five complete
s one-eighth of an inch wide.
tition is completed its angles
with saw-dust and smoothed
secretion so as to make the
e next cell oval or rounded.
ve a uniform depth five-eighths
Here I would like to ask if all
e make their tunnels wider in
each cell than elsewhere?

g many of the tunnels filled
ason one or two of the external
found empty, the bees having
their escape. In the lower cells
gh perfect and active, remain
wing spring, when they break
artitions and escape. In those
e summer all seemingly remain
spring. How it happens that

the bee resulting from the egg last deposited
is the first to escape, when there must of
necessity be weeks of difference in their
time of deposition, is something I cannot
satisfactorily account for. I am led to infer,
by the fact of the external cells always con-
taining males and the lower ones only
females, that the explanation in part lies
therein.

Mr. Davidson found this species was
preyed upon by two parasites—a
Dipteron, *Agyramoeba simsen* Fabr.
and a Chalcid, *Monodontomerus monti-*
vagus Ashm., the latter depositing from
10 to 20 eggs in each cell.

The genus *Anthophora* comprise
rather large solitary bees, clothed with
a thick covering of hairs, especially in
the thorax and hind legs. Almost
nothing is known of the nesting habits
of our species. All those observed by
European authors provision their cells
with a supply of pollen and honey,
upon which an egg is laid and then the
cell is closed up.

Mr. Benj. D. Walsh, in Am. ent.,
vol. 1 (1868), p. 9, has figured and
described the habits of *Anthophora*
abrupta Say (= *A. sponsa* Sm.)
“which had excavated its burrow in
the mortar between the bricks compos-
ing a vast system of underground flues
erected for raising early vegetables,
building an entrance to its burrow of
tempered clay two inches long and
three quarters of an inch in diameter.”
No mention is made of the eggs, dura-
tion of larval stage, etc.

The habits of *Entechnia* (*Antho-*
phora) *taurea* was briefly and incom-
pletely described by Say at the time of

its specific description, Bost. journ. nat.
hist., vol. 1 (1837), p. 411. He says:—

The manners and habits of this species may
be likened to those of *A. parietina* Latr. It
digs a cylindrical hole in compact clay or ad-
hesive earth on the side of a bank, or in earth
retained amongst the roots of an upturned
tree. The hole is two or three inches in
depth; the sides and bottom of a dark brown
color, quite smooth and somewhat polished,
containing a quantity of white pollen, con-
siderably larger than the artificer itself. The
entrance consists of a cylinder extending
downwards from the mouth of the hole more
than an inch in length and consisting of small
pellets of earth compacted together, very
rough on the exterior and smooth within.

The genus *Melissodes* has apparently
the same habits as *Anthophora*, as I once
detected *Melissodes bimaculata* entering
its burrow, formed in an open field, the
entrance to which was directly under a
small, flat stone. Unlike *Anthophora*,
however, it had neglected to build the
tubular entrance so characteristic of this
as well as other solitary bees. On turn-
ing the stone over I found the burrow
after extending about an inch and a half
directly under it curved downward and
became perpendicular, the cell formed
of clay being at the bottom at the
depth of about eight inches.

The genus *Ceratina* is represented
in our fauna by four species, the habits
of only one of which is known, *i. e.*,
Ceratina dupla Say. This species hol-
lows out the stems of almost any pithy
plant in which to nidificate, the elder,
blackberry, raspberry, and syringa be-
ing the most favorite plants. I have
most frequently found its nests in the