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## INSTINCT OR INTELLIGENCE IN THE GREAT GOLDEN DIGGER?

ROY L. ABBOTT

“To know everything and to know nothing according as it acts under normal or exceptional conditions: that is the strange anti-thesis presented by the insect race.” So said that profound student of insects, Fabre, after an immense amount of experimentation. No one has written so entertainingly about insects as has this great Frenchman; few have equaled and none excelled him in the wealth and variety of his observations upon them. But he was trained as a physicist and a mathematician and consequently, brought into his biological studies the viewpoint of the inorganic sciences. That is to say, his experimental animals had to obey clean-cut laws; they either did or they didn't—the exceptions, to him, only proved his rule. Thoroughly convinced of the inviolability of instinct in insect life, he made all their behavior fall under that mysterious guide. Hence his discussions of insect behavior and his general conclusions have all the beauty and terseness of a mathematical demonstration. Fabre is nothing if not convincing, but we need not accept all his conclusions, for “the modern biologist,” says Wheeler, “has been so often deceived by clean-cut theories concerning living organisms that he has grown timid and suspicious.” In other words, Wheeler is here saying that it is dangerous to try to cover all animal behavior with the one conjuring word, instinct. But let us be scientific, and by means of experiment, try to find out whether or not the insect, herself, can answer the point at issue.

The wasp studied in these experiments was the Golden Digger, *Sphex ichneumonea*, a solitary species, the individuals in question making their homes in rather hard-packed sandy soil on the campus of the Iowa State Teachers College. The insect makes her nest by sinking a nearly vertical shaft seven or eight inches into the soil, and then excavating three or four side pockets or cells about the diameter of a pigeon's egg from the sides and bottom of the main shaft. She then provisions each cell with several green grasshoppers or katydids never forgetting to deposit an egg upon the ventral side of one of the victims before closing the mouth of the cell.

The Golden Digger lends herself particularly well to the purposes of these experiments for it is her invariable habit, when returning with prey, to deposit the victim at the entrance and then enter the burrow for an inspection of the premises. She usually enters head-first, backs out, whirls quickly, backs part way into the entrance, then seizing the "hopper" by the antennae drags it after her into the den.

If, under normal conditions, she invariably deposits the "hopper" at the entrance, and then makes a preliminary trip of inspection, she must be obeying an instinctive habit for she does this as a young wasp on the first home that she digs. Can she violate this age-long habit? What will she do if conditions are changed? Here she comes now with a victim; her preliminary inspection trip furnishes me a chance for experiment.

As usual the hopper is left with its antennae almost touching the entrance to the burrow. While she is below, I pick up the creature and lay it six inches away straight back from the burrow. What will she do now?

Out she comes, backwards as usual, whirls instantly, backs part way into the burrow, then makes a quick grabbing motion towards the prey which should be there but isn't. Her expression, if an insect can be said to have one, is almost comical. Where could that "hopper" have gone? Her antennae are extended, she frantically searches about, racing here and there in gradually widening circles, then finally comes upon the victim. Without hesitation, she straddles it, then crawls rapidly with it to the burrow. I bend breathlessly close in my eagerness to see, for she seemingly ignores my presence. What will she do now?

Ah! What abysmal stupidity! Although she has examined the burrow not thirty seconds before, she must deposit her prey at the entrance, and make the usual preliminary inspection. Instinct seemingly must be served! While she is within, I place the grasshopper six inches away as before.

Six consecutive times, she carries the grasshopper to the entrance, and enters leaving it behind, but at last, the experimenter is foiled. On the seventh trip she drags the "hopper" straight into the burrow without stopping!

Presently she come out, kicks a little dirt into the burrow, then "takes off" in search of another victim. I wait an impatient hour for her return. Has she learned anything? Will she carry the next one in directly without preliminary inspection, or failing this, will she do it after fewer trials than before?

At last she returns, carrying a huge katydid larger and heavier than herself. True to form, she deposits it at the entrance and goes bustling in, leaving it behind. I place it six inches away as before, but this time the comedy is repeated only three times. The fourth time I remove it, she comes up, straddles it and goes striding clumsily, head first into the den. Here is something strange! Left to herself, never would she walk head first carrying her prey into the den! She has performed a new action. Moreover, she took this hopper in on the fourth trial; she required seven trials on the first one! Has she learned something? What will she do with the third grasshopper?

The sun is getting low but I must try her once more if possible. I wait another hour. Again she comes heavily laden and again she deposits her prey at the entrance; the old habit is strong. While she is below, I place the "hopper" six inches away. But she is not to be fooled anymore! With a business-like air, she straddles her victim, and, without stopping walks again head first into the den.

I leave her to her own devices for the night, and go away pondering the evidence. She required seven trials at first, then four, then two. This would seem to indicate that she has learned something. If so, will the memory of it hold over till tomorrow?

Next morning, I try once more, and she takes the prey in on the second trial. But here my experiments with this wasp come to an end. I am compelled to leave her for half a day, and on my return, I find her nest has been trampled by some workmen and destroyed.

A few days later, I performed the same experiment on several individuals of the same species. Six different individuals required from three to ten trials each before violating their instinct by carrying their prey into the burrow without stopping for the usual preliminary trip of inspection. On one of these, I was able to perform the experiment a second time, and this one responded by carrying her prey in on the second trial. Two other individuals required thirty-one and forty-five trips respectively before carrying in the grasshopper without stopping, and another picked up her "hopper" on the second trial, flew away with it and never returned. Still another abandoned her seemingly refractory prey on the eighteenth trial, and going down into her den remained there until my patience was exhausted, apparently sulking.

The above type of experiment is not original with me. Those able investigators, the Raus, the Peckhams, Reinhard, and Fabre, have each and all studied this same wasp (or closely related

species) and by the same methods, but the results obtained, and the conclusions drawn from them have been even more diverse than the experimenters themselves. The Raus and the Peckhams see, in some of the experiments described above — intelligence and reason triumphing over instinct. “How shall this change in long-established custom be explained,” ask the Peckhams, “except by saying that her reason (the wasp’s) led her to adapt herself to circumstances?” and I echo their question. How else, indeed?

Reinhard, on the other hand, could not get his wasps to violate their habit of stopping at the entrance with their prey. He dubs them, in consequence, “stupid savants.” But I believe it was his ill-fortune in his experiments to have hit upon only exceptionally stupid individuals, similar to a few that I encountered. Fabre also came to the same conclusions as Reinhard at first, but later found other colonies of wasps which would violate their instinct by carrying in the prey without stopping as described in my experiments. Yet with exactly this data in mind, Fabre writes:

“There are picked tribes, strong-minded families which, after a few disappointments, see through the experimenter’s wiles and know how to baffle them.”

This sounds like a candid admission of their ability to modify conduct according to conditions, but he is apparently not so to be understood. Four pages further on he adds:

“Nature has endowed her with only those faculties called for in ordinary circumstances . . . and as these blind faculties which cannot be modified by experience, are sufficient for the preservation of the race, the insect is unable to go beyond them.”

That is to say, an insect can see through an experimenter’s tricks (though they are entirely new to it) and learn how to overcome them, while utterly unable to modify its blind faculties by experience! But I leave it to the reader to draw his own conclusions.

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