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*EMPIDÆ*  
AND THEIR PREY IN RELATION TO  
COURTSHIP.

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The following observations by Mr. A. H. Hamm, of the Hope Department, Oxford University Museum, will, we feel sure, be of special interest to our readers. The account is reprinted from Professor E. B. Poulton's Report on the Hope Department for the year 1912 in *The Oxford University Gazette* for June 4th, 1913, pp. 952-953:—

"No more interesting and valuable addition to the bionomic series has ever been made than the large collection by which Mr. A. H. Hamm, of the Hope Department, has thrown so much light upon the courtship of the Empid flies.

Results so surprising require abundant proof, and it will be admitted by any one who studies the series that the material both of *Empidæ* themselves and the insects captured or objects seized by them, is of immense extent and most carefully collected, embodying the results of a large number of original observations and most ingenious experiments. The whole of Mr. Hamm's researches were carried out in the neighbourhood of Oxford. The great labour of labelling and cataloguing was finished by Mr. Collins in time for exhibition at the Entomological Congress in August, 1912, where the collection was studied with keen attention and interest. The catalogue numbers—591 in 1908, 771 in 1909, 718 in 1910, and 969 in 1911, large as they are, give a very inadequate idea of the material; for the catalogue is of mounts rather than specimens, of which many are

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constantly carried on a single card. The collection includes many specimens captured and presented by Mr. Hamm's son, Mr. C. H. Hamm.

A part of the results has been already published in the 'Entomologist's Monthly Magazine' for 1908, p. 181, and 1909, pp. 132 and 157; but the most novel and interesting observations and conclusions—those obtained with the genus *Hilara*—are made known for the first time in the following brief account of Mr. Hamm's gift. The full and detailed account awaits publication until numbers of obscure and minute insects—Dipterous captors and prey chiefly Dipterous—have been satisfactorily worked out.

The collection has been classified by Mr. Hamm so as to illustrate his conclusions, the species being arranged in groups, each representing a definite evolutionary stage in the use of prey—first and lowest as food devoured by both sexes without relation to pairing, then as a gift provided by the male and devoured by the female during pairing, finally—as it were an ornament or plaything—no longer eaten by the female, but acting as a lure and a stimulus. In this last stage the prey is often replaced by some vegetable fragment which is quite unsuitable as food. The climax of this line of evolution is reached in an elaborate cocoon spun by the male around the prey and replacing the latter as an object of attraction. This replacement is self-evident in many examples studied by Mr. Hamm; for in these there was nothing but an empty cocoon, the prey having probably been lost during the process of construction.

There are strong reasons for the belief that the last stage has been reached through the second, and the second through the first, but this inference must not be extended further and made to apply to the species themselves.

#### I.—PREY DEVoured BY BOTH SEXES INDEPENDENTLY OF PAIRING.

A. *Tachydromia* (*Tachydrominæ*). Prey very nearly always Dipterous and often belonging to the genus *Tachydromia*, perhaps sometimes to the same species as the captor. The female *in copula* has very rarely been found with prey. 1908—ninety catalogued specimens (or mounts) of which 17 were captured by Mr. C. H. Hamm; 1909—eighty-six of which 2 were captured by Mr. C. H. Hamm; 1911—thirty.

B. *Hybos* (*Hybotinæ*). Prey generally Hymenopterous. 1908—eighty-four of which 26 were captured by Mr. C. H. Hamm; 1909—two; 1911—six.



C. *Empis trigramma*, *punctata* and *scutellata* (*Empinæ*). A little group of related species with habits very different from those of the rest of the genus so far as it has been studied. 1909—sixty-three.

II.—THE PREY PROVIDED BY THE MALE IS DEVoured OR SUCKED BY THE FEMALE DURING COPULATION.

A. *Pachymeria* (*Empinæ*). The prey always Dipterous. 1908—one hundred and ten; 1909—one hundred and seventy-eight.

B. *Rhamphomyia* (*Empinæ*). The prey nearly always Dipterous. 1909—three; 1910—two hundred and fifty; 1911—sixty-five.

C. *Empis* (*Empinæ*). Small species as yet undetermined. Prey nearly always minute *Diptera*, chiefly *Cecidomyia* and *Psychodes*. 1909—two; 1910—fifty-five; 1911—one hundred and three.

D. *Empis tessellata*. Prey very varied, but always Dipterous. 1908—two; 1909—two hundred and twenty-four; 1910—twelve; 1911—thirty-three.

E. *Empis opaca*. Prey like that of *tessellata*, but mainly of the genus *Bibio*. 1909—one hundred and sixty-eight; 1910—forty-six; 1911—forty.

F. *Empis livida*. Prey more varied than that of any other species of the genus, but still chiefly Dipterous. 1908—three hundred and five, of which 4 were collected by Mr. C. H. Hamm; 1909—forty-five; 1911—thirty-two.

III.—THE PREY OR OBJECT PROVIDED BY THE MALE IS NOT DEVoured BY THE FEMALE, BUT BECOMES, AS IT WERE, AN ORNAMENT OR PLAYTHING PROVIDING SOME INDISPENSABLE STIMULUS.

A. *Hilara* (*Empinæ*). Many species as yet undetermined. All the species fly over water, and the prey or other object is always picked up from its surface by the male *Hilara*. The males take floating insects of all kinds - sometimes specially *Diptera*, sometimes Aphids—scales off overhanging trees or other fragments of plants. Some of the species will accept almost any floating object, while others seem to restrict themselves to particular insects, such as *Aphidæ*. When the object is very heavy, the male, after seizing it, spins round with great velocity till the load rises on a cone of water, and is finally lifted from the apex. In Mr. Hamm's experiments, disabled *Diptera* of the genus *Chironomus*, &c., stamens of buttercups, and ray florets of daisies strewn on the water were soon taken by the males, and afterwards found in the possession of the females. Pairing invariably

occurs upon the wing, but numbers of specimens show that a sweep of the net through the swarm at first catches nothing but males carrying the objects that had been strewn on the water, while a later sweep catches pairs still carrying the same objects. The specimens illustrating this investigation are all carefully labelled with the hour and minute at which the different samples were secured.

Mr. Hamm's admirable experiments also enabled him to determine that the females carry the objects provided by the males; for although they are never retained when the pairs are captured, the white florets or the yellow stamens can be seen hanging from the lower *Hilara* of each flying pair, and the lower is invariably the female.

The climax is reached in the males of certain species of *Hilara* which envelope the prey or other minute object in a cocoon, varying greatly in complexity, but in the most extreme cases of striking beauty and regularity. The cocoon is spun upon the wing, so that the method of its construction cannot be followed. Captured individuals are often found to have extruded a viscid globule—probably the material out of which the cocoon is spun. There can be little doubt that in these extreme cases it is the cocoon itself which acts as a stimulus to the female, although the minute and almost invisible object usually enclosed in it, but sometimes dropped, is the stimulus which incites the male to spin. Cocoons that have been dropped, probably after pairing, are constantly picked up and used over again by other males.

These novel and surprising conclusions, obtained as the outcome of Mr. Hamm's energy, resource, and power of accurate observation, are illustrated and confirmed by an immense mass of mounted material, catalogued under 355 numbers in 1910, and no less than 660 in 1911."

