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24. YERKES, R. M. The Harvard Laboratory of Animal Psychology and the Franklin Field Station. *J. of Animal Behav.*, 1914, 4, 176-184.
25. YERKES, R. M. & COBURN, C. A. A Study of the Behavior of the Pig, *Sus scrofa*, by the Multiple Choice Method. *J. of Animal Behav.*, 1915, 5, 185-225.
26. YERKES, R. M. & KELLOGG, C. E. A Graphic Method of Recording Maze-reactions. *J. of Animal Behav.*, 1914, 4, 50-55.

## SPECIAL REVIEWS

*The Lyriform Organs and Tactile Hairs of Araneads.* N. E. McINDOO. *Proc. Acad. Nat. Sci. Phila.*, 1911. Pp. 43. *The Olfactory Sense of the Honey Bee.* N. E. McINDOO. *Jour. Exp. Zool.*, 1914. Pp. 81. *The Olfactory Sense of Hymenoptera.* N. E. McINDOO. *Proc. Acad. Nat. Sci. Phila.*, 1914. Pp. 47. *The Olfactory Sense of Insects.* N. E. McINDOO. *Smithsonian Misc. Coll.*, No. 2315, 1914. Pp. 63.

The papers listed above present the results of about five years of intensive study upon the olfactory sense of certain hymenopterous insects and spiders. The last paper of the series gives not only a resumé of McIndoo's own researches, but also useful reviews of the observations and conclusions of other workers in this field. Its comprehensiveness is indicated by the number of titles listed, one hundred and sixty-four in all, of which but fifteen were not directly accessible.

McIndoo shows from both morphological and experimental data that the so-called "lyriform" organs are the true olfactory structures of the araneads. Thirty-nine species, representing twenty-seven families, were examined. A lyriform organ is usually composed of several slit-like apertures in the cuticle bounded externally by a lyre-shaped, pigmented border. At the base of each slit lies the peripheral end of a sensory fiber. Lyriform organs are found upon all of the appendages and in certain other locations. Tested spiders make distinct responses to the odors of essential oils, but when the lyriform organs are smeared with vaseline the spiders respond nine times more slowly.

In the leading article of the series McIndoo investigates the sense of smell in the honey bee with particular reference to the

structure and disposition of the sensory organs involved. Crucial tests with odors of essential oils (peppermint, wintergreen, thyme, etc.) and with other substances demonstrate the olfactory capabilities of this insect. Bees under experiment were placed in small cases with glass tops and cheese-cloth bottoms, and the odor was presented by quickly uncorking a small vial containing the odoriferous substance and holding it beneath the individual bee. The reaction time was taken in seconds. As is well known, the antennæ of insects are usually designated as the bearers of olfactory receptors and the current antennæ-odor theory is largely based upon data obtained by mutilation methods. As might be expected, injuries to the antennæ of bees are followed by slower reactions to odors, but McIndoo concludes that retardation of response results primarily from the shock of mutilation rather than from direct injury to olfactory structures. Covering antennæ with glue and burning them off is less injurious than amputation although bees so treated are evidently somewhat abnormal. However, they retain the ability to receive odor stimuli for the average reaction time of worker bees with antennæ burned off is 4 seconds as compared with 2.64 seconds for unmutated bees. Numerous experiments similar to the above lead McIndoo to reject the idea that the antennæ of the honey bee receive olfactory stimuli.

Sense organs of several types are found upon the antennæ but to none of them does McIndoo assign an olfactory function. In his opinion certain other structures, the "olfactory pores," are the true organs of smell in the bee, and probably in other insects. Similar sense organs were first noted by Hicks (1857-1860) in various insects. McIndoo finds that the olfactory pores of the bee are grouped upon the bases of the wings, upon all of the legs and scattered over parts of the sting. None are found upon the antennæ. In the very extensive experimental work presented in proof of the olfactory function of these pores it is shown that reaction times to odor are greatly lengthened (eight to twelve times) when the pores are covered with a beeswax-vaseline mixture although behavior is normal in all other respects. A correlation is also established between the number of pores characteristic of each cast and the relative sensitivity of the cast.

In the third paper of the series McIndoo shows that olfactory pores of like structure and location to those of the honey bee are found in 29 species representing 22 families of the Hymenoptera. Experimental work upon *Formica obscuriventris*, *Camponotus penn-*

*sybanicus* and *Vestula maculata* yields results comparable to those obtained with the bee. McIndoo attempts to calculate the relative sensitivity of different species upon the basis of the number of pores present, but an exact evaluation of this relation would seem difficult.

In making a survey of the above papers one is impressed with the painstaking manner in which the work has been conducted, with the variety and ingenuity of the tests employed and, in the case of the honey bee more particularly, with the sound basis of facts from which conclusions are drawn. It would seem well established that the olfactory organs of this insect are the "olfactory pores" and that they are not located upon the antennæ. There can also be little doubt of the presence of similar organs in similar locations on the bodies of the other Hymenoptera studied. Here also experimental results indicate that the antennæ play little or no part in olfactory sensation although the statement that "a few antennæ" (from the 29 species studied) "were hurriedly examined" leaves doubt as to whether or not the organs of Hicks are entirely absent from these structures. It should further be noted that although the olfactory pores may be the "true olfactory apparatus in Hymenoptera" and "the antennæ play no part in receiving odor stimuli" it may yet be doubted if an equally sweeping generalization should be made to include all insects. McIndoo does not hesitate to predict that "when the behavior of insects investigated is thoroughly studied and when experiments are performed in ways other than on the antennæ alone . . . it will be realized that the antennæ can no longer be regarded even as a possible seat of the sense of smell in insects." Such indeed may be the case, but extensive and equally excellent investigations upon other orders will be necessary before this interesting supposition is either established or rejected.

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*Behavior, An Introduction to Comparative Psychology.* J. B. WATSON. New York: Holt & Co. 1914.

This book has been written as a text for students and is to be evaluated in this light. The best organization of any material for the use of students is always a problem, especially in a relatively new subject. As a consequence, the text will probably not meet the entire approval of any teacher, the author himself not excepted.