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A STATISTICAL STUDY OF VARIATIONS IN THE PERIODICAL CICADA.*

HERBERT OSBORN.

One principal variation from the normal type of *Tibicen septemdecim* has been recognized at least since 1829. It was described as a distinct species in 1857, but later Riley† and other authors have given it varietal rank only, and Marlatt in 1898‡ terms it a “dimorphic variety.”

In the occurrence of the present year this form has been very abundant at Columbus and elsewhere, and I have thought it might be worth while to secure some statistical data as to it and to review briefly the question of its relation to the typical form.

Material has been collected from the University grounds and timber near by, from Arlington to the west and Franklin Park to the east of the city, representing points about eight miles apart, and other lots in Cincinnati and at Brush Lake. Observations have been reported to me by Mr. Dury and Professor Geyer, of Cincinnati, and from Prof. Cook, of DePauw University, Greencastle, Ind. These specimens and observations have been corroborative of my own and need not be further mentioned, except when included with precise measurements.

The *cassini* form is smaller than the normal and the abdomen beneath is entirely black, only rare specimens showing a narrow hind border of yellowish or orange yellow. The cross veins of the wing forming the “W” mark are commonly less oblique and the “W” therefore shortened. This point, however, as in the

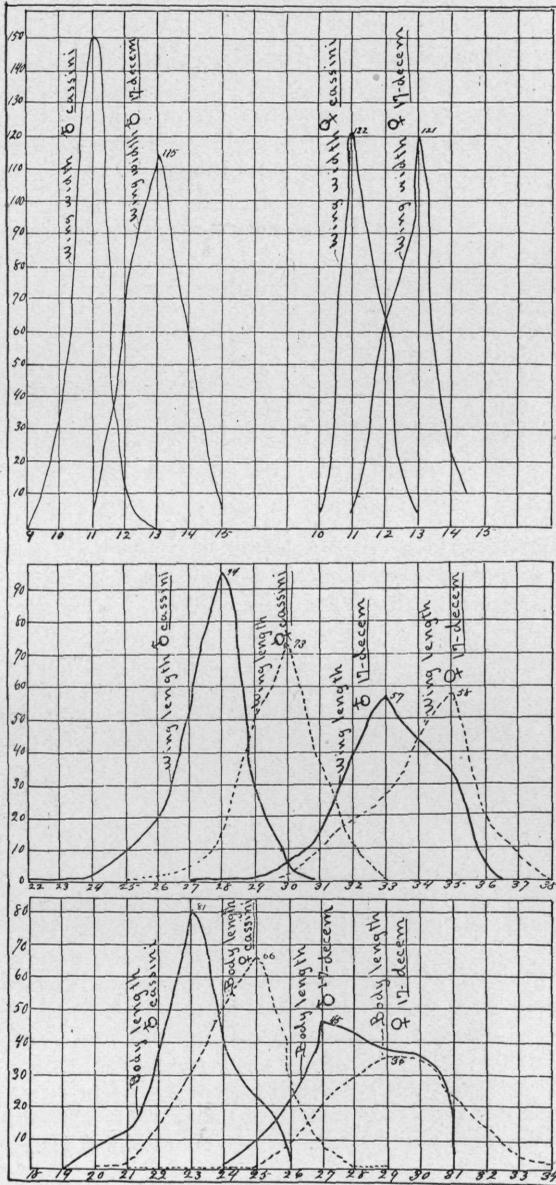
* Read before Section F, Am. Assoc. Adv. Science, Pittsburgh, July 1, 1902.

† Inj. & Ben. Ins., Rep. Mo., 1, p. 20.

‡ Bull. 14, Div. Ent., p. 17.

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Plate 2.



OSBORN ON "VARIATIONS IN THE PERIODICAL CICADA."

normal forms, seems subject to wider variation than the other structures.

Measurements have been made of eight hundred specimens taken at random from various localities, the only point of selection being to get an equal number of both forms (in each sex) in order that the frequencies for each form should be fairly represented. All intermediate forms are represented in due proportion to their occurrence in the lots examined.

Results of the measurements show a very decided constancy for each variety and for each sex of each variety, the wing length of *cassini* males averaging 27.4 mm., width 10.9 mm. and body length 22.9 mm.; while for normal form the wing length is 33.1 mm., width 12.5 mm. and body length 28 mm. For the females, *cassini* form, wing length 30 mm., width 11.3 mm., body length 24.1 mm., while normal 17-decem are wing length 34, width 12.8, body length 29.3 mm. The constancy of each can best be shown by curves of frequency for certain measurements, and this is shown in accompanying plate. Taken by constancy of each form and it must be recognized that their forms are well established.

I may add that measurements, so far as made, indicate same proportion in length of beak and ovipositor and in width of thorax. It is believed that the wing length and width is as good a criterion of variation for the species as any other measurement that could be selected. The length of the entire body varies somewhat with degree of contraction, and for females with condition of ovaries, but in the measurements given this was eliminated, as far as possible, by taking the specimens in same condition of maturity; most of them were dry, but some were killed in formalin.

Color variation is also very constant. In rare instances certain forms showed a narrow orange border to abdominal segments.

There is a difference in genitalia, but apparently not enough to exclude the idea of crossing, and Riley says the difference is not constant. I have not examined a sufficient number to pronounce upon the constancy, but from the method of coition I should think a pairing of opposite varieties, while not impossible, would be difficult. There is a very decided difference in note —, a fact recorded as early as 1830—and this, if the note is a mating call, would certainly have an influence in maintaining this isolation.

A special effort was made to note copulations and determine whether in any case the varieties crossed, or any efforts were made toward crossing, but out of seventy pairs taken in *coitu* not a single instance of *cassini* paired with normal 17-decem form has been seen. There is here, then, a very evident case of isolation due to sexual selection, and it would appear on this basis every opportunity for perpetuation of the variety.

There is, so far as I can learn, no positive evidence that the variety is a dimorph, which may reproduce the normal type, or that alternates with it. It is certainly not a sexual dimorph, as both sexes are represented in each form, and, as shown, elsewhere, pair by themselves; seasonal dimorphism is evidently not to be considered, so that I see no reason to use the term "dimorphic" as applied to this species.

The fact that the two forms appear simultaneously in the seventeen-year period and have so many characters in common is certainly good evidence of a very close relationship, and it would seem safe to say that they have sprung from a common stock, or very likely that one is a derivative from the other, which still represents the ancestral form. While not yet determined, it would seem pretty evident that *cassini* is the derived form, since it appears less commonly than the other and has probably a more restricted range. If, possibly, a depauperate variety, it seems now to be fully established as a distinct form. It pertains especially to the brood XXII having such wide range the present season (1902), and was noted especially by Riley for the same brood in 1868.

In my own experience it has been very rare in broods V and XIII, which I have had good opportunities to observe in Iowa in the occurrences of 1878, 1888 and 1895.

Summarizing: (1.) There is a very constant color difference. (2.) Measurements show very close adherence to two entirely different averages for length of body, length of wing and width of wing. This is best shown by curves. (3.) There is a totally different note characteristic of each form, which must be considered as representing different morphology of sound-producing organs as well as basis for selection of mates. (4.) No *cassini* forms have been found paired with normal forms and none have been recorded or reported by other observers. (5.) There is a difference in genitalia, though perhaps not enough to exclude the possibility of mating, and Riley says the differences are not constant.

Whether this form be called a variety, sub-species or species, is, it seems to me, of less importance than a recognition of its distinctness, and a determination, if possible, of its phylogenetic relationship. For purposes of designation it may conveniently be called *Tibicen cassini* Fisher.

A variation of a quite different type was noted, but was represented by only two specimens.

I am under obligation to Max W. Morse for assistance in making the measurements.