INHERITANCE OF SOME VARIETAL CHARACTERS
IN CHRYSOPA OCULOATA SAY (NEUROPTERA:
CHRYSPIDAE)*

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Varieties of Chrysopa oculata Say are distinguished by
the degree of darkness of wing veins and by color patterns,
chiefly markings on the genae, vertex, and pronotum. Most
of the varieties are species synonyms. C. albicornis Fitch,
which has dark cross veins, and C. chlorophana Burm.,
which has green cross veins, were placed under C. oculata
Say by Smith (1922). One of several reasons for doing
so was the fact that the forms readily cross.

Smith (1932 and 1934) recognized five varieties which
have different color patterns on the vertex. In carei Smith,
spots on the vertex are absent. In xanthocephala Fitch
there are two black or brown spots in the antennal band
or closely connected with it; but if the two spots are not
connected with the antennal band the form is called bipunc-
ata Fitch. Variety oculata Say has four dark spots on the
vertex (pl. 5, A). In illepida Fitch there are two elongate
bands; in other words the spots on each side are fused
(pl. 5, B).

When large numbers of Chrysopa oculata are examined
it is found that some specimens cannot be placed in the
recognized categories. A good example is a form in which
the vertex has two spots on one side and an elongate band
on the other (pl. 5, C). In an attempt to clarify the status
of some of the varieties, an investigation was made of
the inheritance of some characters upon which varieties
are based.

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in interpreting the possible genetic status of the varieties.

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Field-collected gravid females were put in separate fruit jars with cheese-cloth coverings, and eggs obtained from them were isolated in one-ounce bottles with absorbent cotton plugs. Larvae were given about a dozen field-collected aphids every day or every other day. Sometimes larvae were fed termite workers. They spun cocoons, pupated, and emerged in the small bottles. Adults lived and reproduced satisfactorily in fruit jars. They were given a few aphids and a little water daily. The average duration of the egg stage was approximately three days and the larval stage, 14 days. Adults usually emerged 14 days after the cocoon was spun.

Two varieties were reared, inbred and inter-bred, namely the common *oculata*, which has four spots on the vertex, and *illepida*, which has two elongate bands on the vertex. Seven *oculata* females of unknown ancestry, some from different localities in Maryland, produced 103 offspring. Of these, 101 or 98% were *oculata*. There were one *illepida* and one *xanthocephala* (a form with only two spots). The progeny of two wild *illepida* females consisted of 83 individuals, 58 of which were *oculata* and 25 of which were *illepida*—respectively 70% and 30%.

Twelve pairs of first generation individuals were mated so that offspring of nearly all possible combinations could be studied. To determine whether or not there was any sex linkage, duplicate crosses were made in which the sexes with given characters were reversed.

Results of second generation pairings are given in Table 1. It is obvious that the genes responsible for *oculata* are more prevalent. This appears to be true not only in the populations reared but also throughout the range of the species. It is unlikely, however, that *oculata* is a dominant character in the Mendelian sense, because of its occurrence in offspring from *illepida* parents. Pairing F as given in the table shows that one pair of *illepida* from an *illepida* female produced 50% *oculata* offspring, indicating that they carried the *oculata* gene. This high percentage fur-

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**EXPLANATION OF PLATE 4**

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nishes proof that oculata is not a simple dominant. Furthermore, in B, C, and E oculata, presumably heterozygous if illepida is recessive (because they were the offspring of illepida females) produced low percentages of illepida. If oculata were dominant the expected proportions of illepida would be 25% in B and C, and 50% in E.

The high percentage of oculata offspring in all the crosses occurs in a manner showing close approximation to the results expected from segregating recessives with a rare production of illepida, which could be explained by the presence of two or more pairs of recessive genes either of which in the homozygous recessive state could produce oculata. Thus, if there are two genes any one of which in the recessive state would produce oculata, a cross like those in D (Table 1) could theoretically produce 25% illepida, provided that the illepida parent is heterozygous for both pairs of genes. The actual number obtained was 19%. If it is assumed that any one of three genes in the recessive state might produce oculata, the actual ratios of the five crosses will conform more closely with the theoretical.

Whatever the genetic mechanism may be, it can be concluded that illepida is not a simple recessive. If such were the case, inbreeding could not possibly produce anything except illepida, but actually the result is 50% oculata. (Table 1, F.) Conversely, the fact that inbreeding of five pairs of oculata from an oculata female gives only oculata suggests that this character may be a recessive. There are of course the other patterns on the vertex to be considered, but no attempt is being made to explain their occurrence.

Even though the manner in which the variations are produced cannot be explained easily and regardless of the percentages of the two varieties obtained from the different crosses, the important point is that the characters which have caused the naming of oculata and illepida are inherited. Moreover this appears to be true for the other varieties previously mentioned, including those with differences in darkness of wing venation.

An eighth variety recognized by Smith (1932) is separata Banks which "is distinguished by the absence of a connection between the black loop under the antennae and the black genal band." If the connection is very faint the
form is still called separata. There are various degrees in reduction of width of this connecting band, and in this case it appears that the character is so subtle that it is not reliable.

Because of inconsistencies and intergradations in color patterns and because the genetic status of some of the varietal characters is at least partially understood, it seems reasonable to conclude that the varietal names are no longer of any value. The avoidance of the term variety where it lacks real meaning is one of the principles set forth by Ferris (1928). If this principle is applied the work of the taxonomist will be simplified. He no longer has a problem when he is confronted with borderline cases such as individuals with spots on one side of the vertex and a band on the other, and specimens with the face as in separata, the vertex as in illepida, and the wings as in albicorns.

Table 1. Inbreeding and crossing of two varieties of Chrysopa oculata (Say); oc(oc) indicates oculata from an oculata female; oc(iill) indicates oculata from an illepida female; ill(iill) indicates illepida from an illepida female.

<table>
<thead>
<tr>
<th>Pairing</th>
<th>No. of Pairs</th>
<th>Total No.</th>
<th>oculata Off-</th>
<th>illepida Off-</th>
<th>Borderline Off-</th>
</tr>
</thead>
<tbody>
<tr>
<td>A oc(oc) x oc(oc)</td>
<td>5</td>
<td>84</td>
<td>84%</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>B oc(oc) x oc(iill)</td>
<td>2</td>
<td>83</td>
<td>78%</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>C oc(iill) x oc(iill)</td>
<td>1</td>
<td>11</td>
<td>10%</td>
<td>91%</td>
<td>1%</td>
</tr>
<tr>
<td>D oc(oc) x ill(iill)</td>
<td>2</td>
<td>59</td>
<td>48%</td>
<td>81%</td>
<td>11%</td>
</tr>
<tr>
<td>E oc(iill) x ill(iill)</td>
<td>1</td>
<td>60</td>
<td>39%</td>
<td>65%</td>
<td>21%</td>
</tr>
<tr>
<td>F ill(iill) x ill(iill)</td>
<td>1</td>
<td>18</td>
<td>9%</td>
<td>50%</td>
<td>8%</td>
</tr>
</tbody>
</table>

SUMMARY

Two varieties of Chrysopa oculata Say were reared, inbred, and interbred, namely, the common oculata, which has four spots on the vertex, and illepida, which has two elongate bands on the vertex. Twelve second generation pairings were made and 315 offspring obtained. All of these pairings resulted in high percentages of oculata. It is, therefore, concluded that the genes responsible for this character are more prevalent. However, oculata is not a
simple dominant, and there is evidence which suggests that there are two or more genes, any one of which in the recessive state produces oculata. Because of inconsistencies and intergradations in color patterns and because the genetic status of some of the varietal characters is partially understood, it may be concluded that the varietal names are no longer of any value.

LITERATURE CITED

FERRIS, G. F.

SMITH, R. C.
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