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A UNIQUE FRATERNITY IN *HABROBRACON*.

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(With Plate XXII and Nine Text-figures.)

THE parasitic wasp, *Habrobracon juglandis* (Ashmead), produces males by haploid parthenogenesis and females from fertilised eggs. Occasionally a mosaic male appears developing from an unfertilised binucleate egg of a heterozygous mother. The two original cleavage nuclei are presumed to be derived from the second oöcyte division, which is reductional for the factors concerned (post-reduction). Thus in this case the second polar nucleus, as well as the egg nucleus proper, functions in parthenogenetic cleavage.

Crosses have been made between wasps with the mutant traits white, **wh** (eyes), and shot-veins, **sv** (wings). In shot-veins the wing veins are irregularly broken. F_1 wild-type virgin females (**wh**/ + . + /**sv**), produce males of four types—wild-type with black eyes and normal wings (+ . +), black-eyed with shot-veins (+ . **sv**), white-eyed with normal wings (**wh** . +), and a new type with shot-veins and variegated eyes (**wh** . **sv**). The fourth class is of especial interest, for it appears that the factor shot-veins in combination with factor for white causes small orange or reddish spots to appear, especially in the ventral region of the white eyes (variegation).

Variegated males (**wh** . **sv**) crossed with white females (**wh**/**wh** . + / +) produce females (**wh**/**wh** . +/**sv**) with the trait shot-veins showing much less distinctly in the wings, and with eyes having orange flecks of smaller size and paler colour than in variegated males (**wh** . **sv**) or in variegated females homozygous for shot-veins (**wh**/**wh** . **sv**/**sv**). The two traits determined by **sv** therefore exhibit incomplete dominance, the effect of the mutant factor being much more dominant in eyes than in wings.

In order to determine the effect of **sv** on white eyes if the factor for orange eyes (**o**) was also present, a certain female from pure variegated stock (**wh**/**wh** . **sv**/**sv**) was crossed with an orange-eyed male (**o**). Male offspring were variegated (**wh.sv**) as expected, and F_1 females were wild-type with black eyes and normal (or near normal) venation

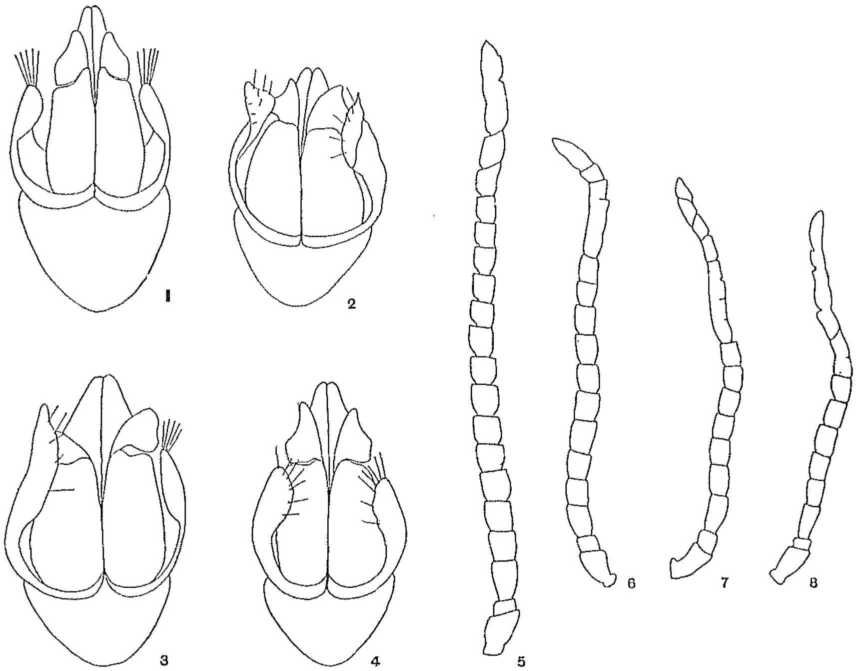
(**wh**/+. **sv**/+.+/**o**).

These females bred as virgins produced male fraternities segregating the three genes. Seven phenotypically different classes appeared—wild-type with black eyes and normal venation (+.+.+), orange (+.+.**o**), shot-veins (+.**sv**.+), orange shot-veins (+.**sv**.**o**), white which were approximately twice as frequent as the others since orange is masked (**wh**.+ . + and **wh**.+.**o**), variegated (**wh**.**sv**. +), and light variegated (**wh**.**sv**.**o**). It is interesting to note that the triple recessive has variegated eyes, although the spots are smaller and paler, resembling those in white females heterozygous for shot-veins (**wh**/**wh**.+/**sv**). Variegated (**wh**.**sv**. +) and light variegated (**wh**.**sv**.**o**) are readily separated, and hence the factor shot-veins acts as a differentiator of orange in the presence of white. No linkage obtains between these genes.

One of the F_1 females produced a fraternity of 186 regular adults, 10 immature and hence indeterminable for one or more of the traits, and a mosaic male (No. 612). Four of the ten immature and 78 of the 186 classifiable for various other traits showed a new, readily distinguishable, antennal difference which we have called attenuated (Text-figs. 5–8). Genitalia of attenuated are malformed to greater or less extent (Text-figs. 2–4). Many attempts were made to obtain matings of attenuated males, but with no success. The antennal defect apparently caused sexual indifference on the part of the males, due probably to defective sense organs, but even when matings were attempted, they could not be accomplished. The associated defects of antennae and genitalia recall a strain of "deficient," showing fusion and tapering of antennal segments and malformation and reduction of genitalia (Whiting, P. W., 1926, pp. 379–81). These deficient occurred in significantly higher frequency among the progeny of middle-aged than of young or old mothers.

According to our usual method the mother of the attenuated males was transferred every three or four days (through vials *a* to *j*). Later vials then indicate advancing age of mother. Attenuated/total offspring were for the various vials as follows: *a*, 13/20, 65 per cent.; *b*, 3/5, 60 per cent.; *c*, 16/21, 76 per cent.; *d*, 10/31, 32 per cent.; *e*, 3/8, 37 per cent.; *f*, 3/14, 21 per cent.; *g*, 10/29, 34 per cent.; *h*, 14/36, 39 per cent.; *i*, 6/17, 35 per cent.; *j*, 0/5, 0 per cent. The sudden drop from *c* to *d* with the consistently high ratios previously and low ratios subsequently is to be noted. On account of small numbers no differences are statistically significant in themselves, but total from vials *a* to *c* (32/46, 69·56 per cent.)

is significantly higher than total from *d* to *j* (46/140, 32·86 per cent.). The difference (36·71 ± 7·86) is 4·7 times its standard error. It appears then that ratio of attenuated like that of deficient may be determined in part by age of mother.



Text-figs. 1–8.

Text-fig. 1. Genitalia of normal male, × 240.
Text-figs. 2–4. Genitalia of attenuated males, × 240.
Text-figs. 5–8. Antennae of attenuated males, × 100.

TABLE I.

	Wild-type	Shot-veins	Orange	Orange shot-veins	White	Varie-gated	Light varie-gated
Non-attenuated	5	5	7	5	37	29	20
Attenuated	16	17	10	16	8	4	7

The 186 regular mature offspring are recorded in Table I. Attenuated are 41·9 per cent. of total, white are 56·5 per cent., and shot-veins are 55·4 per cent. Orange are 46·1 per cent. of the 141 remaining after excluding the 45 white among which orange are indeterminable. There are no significant deviations from expectation on basis of independent distinct from the black. Two mosaics for cantaloup and ivory have been reported (Whiting, P. W., 1932 *b*). These showed cantaloup in definitely marked off regions bordered by black which graded through orange into ivory.

This reconstitution of the double dominant effect at the border of two different recessives is considered as due to some soluble substance produced by the factor *O* present in the white or cantaloup region. No reciprocal influence of **Wh** or **C** from the orange (or ivory) region is noted. The relationship may be expressed:

$$\begin{array}{l|l} \mathrm{O}\ \text{—} & \rightarrow \mathrm{o}\ (\mathrm{o}^{i}) \\ \mathrm{c} & \mathbf{C} \end{array} \qquad\qquad \begin{array}{l|l} \mathrm{O}\ \text{—} & \rightarrow \mathrm{o}\ (\mathrm{o}^{i}) \\ \mathrm{wh} & \mathbf{Wh} \end{array}$$

Investigations are now under way to determine whether there is any influence causing a black band, however narrow, in an eye which is mosaic for white and cantaloup.

$$\begin{array}{c|c} \mathrm{wh} & \mathbf{Wh} \\ \mathbf{C} & \mathrm{c} \end{array}$$

This one fraternity then shows lightening of variegation by orange, a new mutant type and its linkage relationship, as well as an effect of age of mother on the ratio of its appearance. There occurred in this fraternity a male mosaic for the new trait as well as for three other characters, two of which, recessive eye colours, illustrate reconstitution of the double dominant effect at the border of the genetically diverse tissue.

REFERENCES.

WHITING, P. W. (1926). "Influence of age of mother on appearance of an hereditary variation in *Habrobracon*." *Biol. Bull.* **51**, 371–85.

—— (1932 *a*). "Asymmetry of wild-type traits and of secondary sexual characters in mosaics of *Habrobracon*." *Journ. Exp. Zool.* **62**, 259–69.

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EXPLANATION OF PLATE XXII.

Fig. 1. Right eye of mosaic male, No. 612, × 240.

Fig. 2. Left eye of mosaic male, No. 612, × 450.

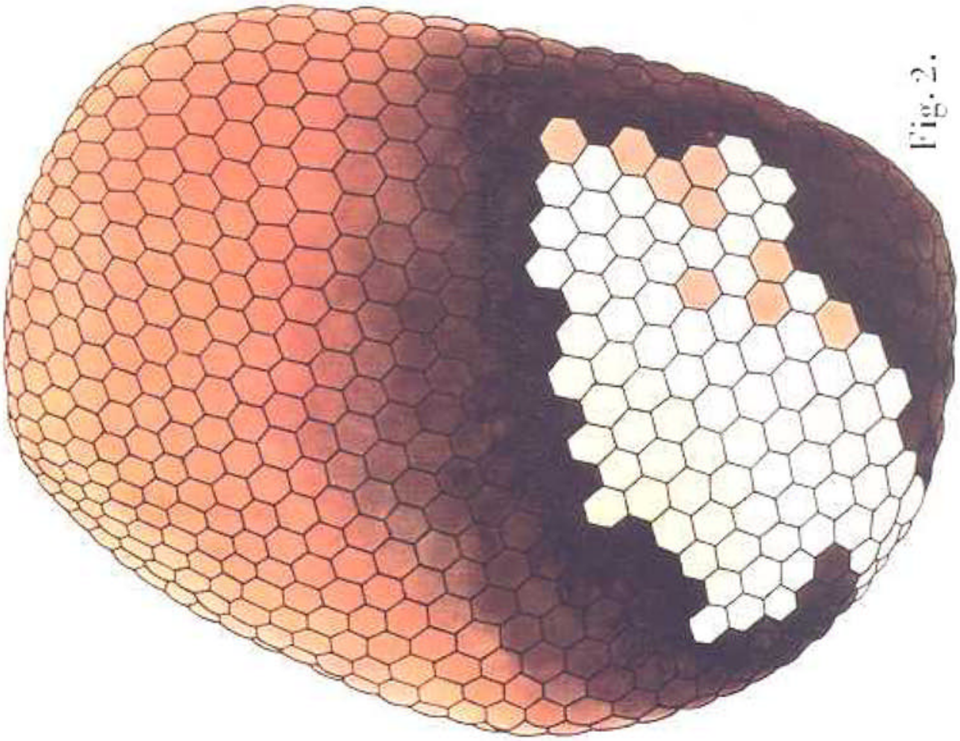

Fig. 2.

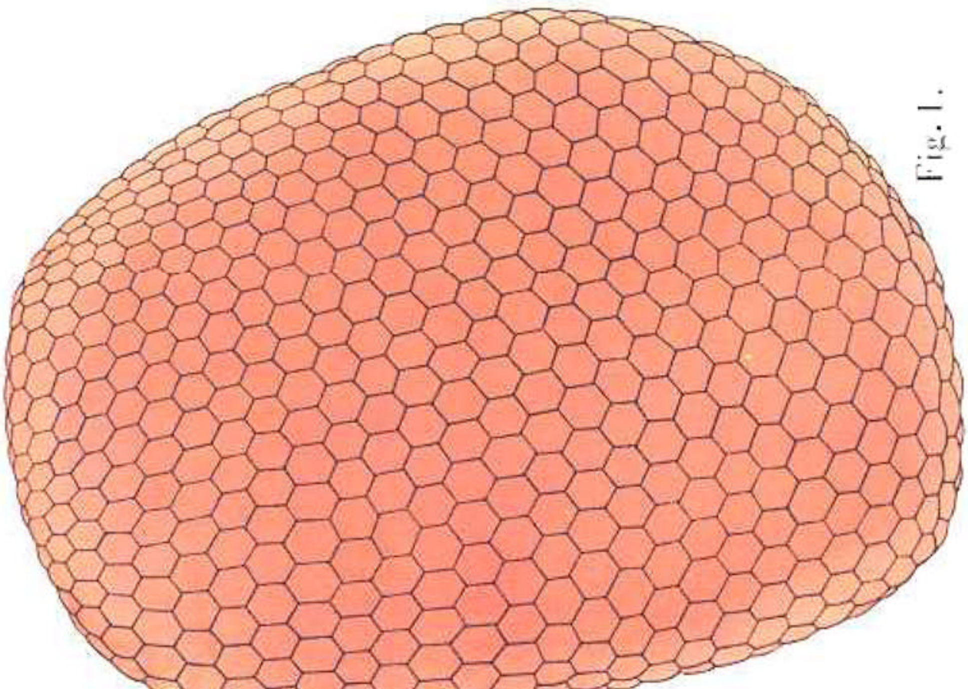

Fig. 1.