THE BEHAVIOUR OF PLAXATE, A MUTANT GENE OF *DROSOPHILA ANANASSAE*

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Received July 4, 1936

Plexate (*Pt*) of *Drosophila ananassae* is a dominant mutant gene located in the second chromosome. As previously described (Moriwaki, 1935), the homozygous flies are not viable, the heterozygous character manifesting itself in various degrees; a weak manifestation showing only fusion of the end of the second longitudinal vein with the costa. The third allelomorph, Plexate² has been found by Kikkawa (unpublished data; *V. Drosophila Information Service*, No. 3, 1935), the gene expressing the character in a less pronounced manner. Concerning the gene Plexate, two outstanding facts were found independently, as described in this paper.

I wish here to express my gratitude to Professor Y. Imai for his valuable advices and kind criticisms.

Balloon expression of plexate

In the stock of Plexate, some Plexate flies accompanied with a balloon¹⁾-like character, were found at times. On the other hand, I believed that this tendency could be enhanced by the presence of heterozygous balloon. To confirm it, I first made crosses of heterozygous *Pt* with balloon, with the following results;

$$(Pt / +) \times (ba)$$

	<i>Pt</i>				
	<i>Pt</i>	<i>ba-Pt</i>	total	+	Total
Females	819	290	1109	1215	2324
Males	819	157	976	1339	2315

That these Plexate flies with balloon expression were not homozygous with respect to balloon was confirmed by test crossing. From the above data

1) Balloon (*ba*) of *D. ananassae* is a mutant with inflated wings, the gene being located in the third chromosome.

the appearance of the balloon expression seemed to be more frequent in the female. The actual frequencies as calculated worked out to

$$F^{ba-Pt} \text{ in female} = 26.1\%$$

$$F^{ba-Pt} \text{ in male} = 16.1\%$$

$$F^{ba-Pt} \text{ in a male} / F^{ba-Pt} \text{ in female} = 61.7\%$$

$$(F^{ba-Pt} = \text{Frequency of balloon-Plexate among total Plexate})$$

Next I investigated the appearance of the balloon-expressed Plexate in the progeny of the cross, Plexate with normal flies. As almost all these crosses were originally planned for another experiment, there were included in them two unrelated characters, namely, cardinal and spineless, which are not considered here. The result is tabulated as follows:

$$(Pt / +) \times (+)$$

	Pt				
	Pt	$ba-Pt$	total	+	Total
Females	3046	97	3143	3216	6359
Males	3013	49	3062	3237	6299

$F^{ba-Pt} \text{ in female} = 3.1\%$
 $F^{ba-Pt} \text{ in male} = 1.6\%$
 $F^{ba-Pt} \text{ in male} / F^{ba-Pt} \text{ in female} = 51.6\%$

By comparing the results of these two cases, we can say that with the presence of heterozygous balloon the appearance of balloon-Plexate could be enhanced about tenfold. It may also be concluded that sexual differences must be recognized in the matter of the frequency of $ba-Pt$; the actual number will be calculated later.

From the latter cross, two different pairs were selected for the next investigation. One pair was a culture (series S) raising prolifically $ba-Pt$ flies, such as the females of Pt 30, $ba-Pt$ 38, + 55 and males of Pt 48, $ba-Pt$ 16, + 83; while the other was a pair (series W) without $ba-Pt$ flies, but of 163 Pt and 152 +. Between them, many various crosses were tried, such as (1) ♀ $ba-Pt$ (S) × ♂ $ba-Pt$ (S), (2) ♀ $ba-Pt$ (S) × ♂ Pt (W), (3) ♀ Pt (W) × ♂ $ba-Pt$ (S), (4) ♀ Pt (S) × ♂ Pt (S), and (5) ♀ Pt (W) × ♂ Pt (W), the results of which are shown in Table 1.

Seeing that there is a distinct difference between the frequency of $ba-Pt$ in case 4 and that in case 5, we can presume pedigree difference in its expression. Moreover, comparison of case 1 with case 4 shows that both $ba-Pt$ and Pt of series S must have been almost equally possessed with the potency for the expression. Concerning the ability to manifest balloon character additionally to the Plexate, its true form, whether it is due to the fourth allelo-

morph or to a modifier cannot yet be determined. All we can say is that it is heritable. It moreover seems possible to select the factor, because I obtained two lines, one of which was selected from series S showing a high frequency of *ba-Pt*, while the other, which was selected from series W, gave no *ba-Pt*.

Table 1

Cross	Females				Males			
	<i>Pt</i>	<i>ba-Pt</i>	+	Total	<i>Pt</i>	<i>ba-Pt</i>	+	Total
1 { ♀ <i>ba-Pt</i> (S) ♂ <i>ba-Pt</i> (S)	123	46	112	281	139	18	99	256
2 { ♀ <i>ba-Pt</i> (S) ♂ <i>Pt</i> (W)	117	11	60	188	95	3	63	161
3 { ♀ <i>Pt</i> (W) ♂ <i>ba-Pt</i> (S)	139	2	90	231	117	4	88	209
4 { ♀ <i>Pt</i> (S) ♂ <i>Pt</i> (S)	141	32	112	285	195	11	139	345
5 { ♀ <i>Pt</i> (W) ♂ <i>Pt</i> (W)	271	5	152	428	239	2	124	365

By examining the mode of appearance of *ba-Pt*, I concluded that the character would be more frequently expressed in the early emerged flies of the culture, as shown in Table 2.

Table 2

Character	Females		Males	
	Early emerged	Late emerged	Early emerged	Late emerged
<i>Pt</i>	917	432	988	429
<i>ba-Pt</i>	225	28	90	10
Total	1142	460	1078	439
<i>Fba-Pt</i>	19.7%	6.1%	8.3%	2.3%

The fact that the frequency of *ba-Pt* flies lessened in late emergence may partially explain the cause of uncertainty of expression.

As it was confirmed that there has been always a difference in the expression of *ba-Pt* between the two sexes, nearly parallel in both the strong and weak cases, I calculated the actual rate in my available data such as, *Fba-Pt* in male / *Fba-Pt* in female = 52.0%. Such a sexual difference can be seen very frequently in *D. ananassae*, as pointed out elsewhere (Moriwaki, in press).

Unexpected normals due to reversion of plexate

In my recent work (Moriwaki, 1936), when I was investigating the occurrence of crossing over in the male of *D. ananassae*, gene Plexate was used together with cardinal(*cd*) and spineless(*ss*). The offspring of cross $\varphi \left(\frac{cd\ ss}{cd\ ss} \right) \times \delta \left(\frac{Pt}{cd\ ss} \right)$ were observed, including the control, the heat, and the X-ray series. The result is shown here again in Table 3.

Table 3

Experiment	Total	$\overbrace{0(0.0)}^{cd\ ss\ Pt}$	$\overbrace{1(25.9)}^{cd\ Pt\ ss}$	$\overbrace{2(0.8)}^{cd\ Pt\ ss}$	$\overbrace{1,2}^{cd\ Pt\ ss\ +}$
Control	3560 { Females	899 951	0 0	0 0	0 (15)
	{ Males	951 832	0 0	0 0	0 (12)
Heat	1782 { Females	460 440	0 0	0 0	0 0
	{ Males	460 422	0 0	0 0	0 0
X-rays	8325 { Females	2125 2126	8 10	0 0	0 (20)
	{ Males	1988 2011	12 5	0 0	0 (20)

The loci of the three genes were recently renewed as 0.0 *cd*, 25.9 *Pt*, and 26.7 *ss*, by counting 4147 flies.

As suggested there, phenotypically normal flies could not be regarded as double crossovers, seeing that the frequency of their appearance was too high. They are supposed to be the result of a reversion of *Pt* to +. Another reason for our assumption of the reversion is that the ratio of *Pt* to *cd ss* was always

Table 4

Sex	Case 1 (Control)			Case 2 (Control)			Case 3 (X-rays)		
	+	<i>Pt</i>	<i>cd ss</i>	+	<i>Pt</i>	<i>cd ss</i>	+	<i>Pt</i>	<i>cd ss</i>
Females	2	1	4	13	15	34	20	44	75
Males	2	0	4	10	17	44	20	41	68
Total	$\overbrace{4\ 1}^5$	8		$\overbrace{23\ 32}^{55}$	78		$\overbrace{40\ 85}^{125}$	143	

low in each of the three cultures (two in the control) where the normal flies appeared. The sum of the normal flies and the *Pt* flies in each culture was almost equal to that of the *cd ss* flies, the same as in general cases as shown in Table 4.

Of these normal flies, fifteen females and fifteen males were examined for their fertility and genetic constitutions, when the former were found to be normal, while the latter were $\frac{+}{cd\ ss}$ as expected. These facts may confirm the reversion view.

As reversion was seen also in the control, I suspected the Plexate gene to be of mutable disposition. The same cross ♀ $\left(\frac{cd\ ss}{cd\ ss}\right) \times \text{♂} \left(\frac{Pt}{cd\ ss}\right)$ was then repeated by pair culture, in which the progeny were observed until the third brood. But the result was negative as shown in Table 5.

Table 5

Character	1st brood	2nd brood	3rd brood	Total
Pt { Females	991	1268	385	2644
{ Males	971	1313	340	2624
				5268
$cd\ ss$ { Females	1008	1278	381	2667
{ Males	1038	1258	379	2675
				5342
$+$ { Females	0	0	0	0
{ Males	0	0	0	0

Since the later data show no mutable disposition of Pt , the mutability in the previous experiments seems to have enhanced as the result of certain causes unknown.

Summary

I. a) Plexate flies of *Drosophila ananassae* were sometimes accompanied with a balloon-like character. b) This character can be inherited, and the factor, though its true form has not yet been determined, seems possible to be selected. c) By the presence of heterozygous balloon, this tendency is enhanced. d) Although the expression of the unknown factor is uncertain, it is partially affected by the time of emergence, appearing more frequently in the early emerged flies. e) Sexual difference, which was recognized in the expression of the character, is reduced by half in the male.

2. a) Reversion of Plexate to normal gene was found. b) Owing to suspicion with respect to its mutable disposition, investigations were repeated, but with negative results.

Literature cited

- MORIWAKI, D. 1935 Some mutant characters in *Drosophila ananassae*. *Genetica*, **17**: 32-46.
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摘 要

アナナス猩々蠅 (*Drosophila ananassae*) の一優性遺傳子 Plexate に關連した二つの事實に就て叙述した。

一つはこの Plexate に伴つて balloon の様な形質が表現されることのある事實で、この傾向が遺傳的であることを知つた。その形質を現はす factor がどんな形式のものかは未だ決定されないが、或る程度の淘汰は可能らしい。Plexate は第二染色體に屬すると考へられるが、第三染色體にある balloon 遺傳子がヘテロの状態と同じくヘテロの Plexate (ホモは致死である) に伴ふ時に上述の傾向が更に強められる。次に、この factor の表現は區々であつて、この形質を伴ふもの同志を交配しても全く之を現はさないものが相當數生ずる状態だが、その原因の一部は蠅の羽化する時期にあるらしい、即ち同一飼育罐中では初期に羽化したもの程多くこの形質を表現すると考へられる。更に知られた事はこの表現率が雌雄で異なる點で、一般に雌に於ける方が率が高く雄の約 2 倍に達するのである。

Plexate に關する今一つの事實といふのは、Plexate が normal gene に逆戻り (reverse) したといふ現象である。それが單なる reversion にしては少し數が多過ぎる様に思つたので、或は mutable な傾向でも存在するのではないかとの豫想をいだいて實驗を繰返して見た。その結果は豫期に反して全く reversion を伴はなかつた。