Contribution to the Determination of the Imaginal Discs in *Drosophila*

Recently, by Roentgen irradiation of *Drosophila* larvae in the early third larva stage WADDINGTON[1] obtained both duplications of individual adult organs (e.g. the palpi, the wings and the scutellum) and diversions of the normal development trajectory of certain discs (so e.g., transformation of wing tissue into body cuticle or the arista base into leg-like tissue). Hereby it was clearly proven, against the prevailing opinion, that also with *Drosophila*, the imaginal discs in the early third larva stage are only *labilely determined* and still partly *regulateable*. STEINBERG[2] and CHEVAIS[3] came to the same result for the eye discs. The authors showed in particular with the mutant *bar* that by a temperature stimulus or by the supply of a certain extract in the first half of the third larva stadium initiated an increase in the facet number based on a *dedifferentiation* of the presumptive headchitins, there the facet number increased without enlargement of the late-forming headchitin and eye facet forming imaginal disc (briefly, "eye disk" mentioned).

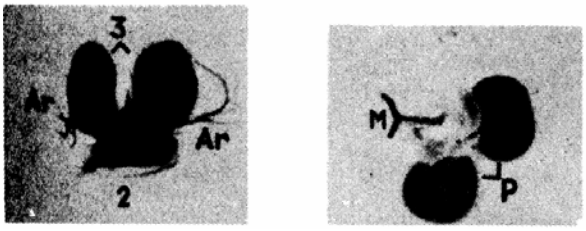

Fig. 1. Duplication of the antenna (a) and the palpus (b) in a bissected eye antenna disc of a 3 days and 21 hours old *D. hydei* donor larva 8 days after implantation into a equivalent host larva. 2 = unduplicated second antenna limb. 3 = both third antenna limbs with associated ariste (*Ar*). *M* Maxille. *P* both Palpi. 60/1

Our investigations now bring further experimental proof for the determination and lability to regulation of *Drosophila* early third instar imaginal discs. I used the same experimental technique, which BODENSTEIN[4] used in an earlier work, i.e. I transplanted halved imaginal discs of larvae into the body cavity of other equivalent larvae and examined afterwards the implants in the eclosed adults. The only difference between my transplantions and those BODENSTEIN was that I already operated in first half instead of the second half of the third larval stadium. Now in analogy with the findings WADDINGTON, I succeeded in obtaining double and partial three-fold formations of the antennae, the palpi, the ocelli and the legs (Fig. 1 and 2), as well as occasionally obtained a transformation of the presumptive arista base into leg-like structures.

Three details are still particularly emphasized:

1. WADDINGTON[1] assumed that the palpi and antenna duplications observed by him developed from converted presumptive eye tissue. This does not appropriately apply to the duplications observed by me.

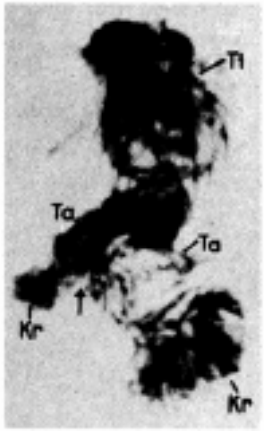

Fig. 2. Duplication of three distal tarsal segments with accompanying claws (Kr) in a bissected leg disc of a likewise 3 days 21 hours old *D. hydei*-donor larva, 8 days after implantation in the same age host larva. (In an attempt to bring 4 claws into one plane for the photographic image, the right tarsal branch was printed broadly.) *Ta* Tarsus, *Ti* Tibia. Arrow - point of bissection. 120/1

Thus it occured that in all series of tests in which I separately transplanted the halves of the "eye disc" and the "antenna disk" (eye and antenna disk are normally connected in *Drosophila*), only aristae and palpi duplications were in the halved antennae, while in halved eye discs I never observed an arista or a palpus develop, probably however there was an ocellar increase.

Thus, the multi-formations here concern only those normally presumptive organs of the individual disk.

2. If one examines the distribution the aristae and palpi duplications for the two implanted halves, then it is noticeable that frequently the two aristae and/or palpi are formed by an implant half, while the second implant half only exhibits different head structures. This applied e.g. to 20 of 30 arista cases and to 14 of 25 palpus cases. One may conclude from this unequal distribution that the antennal disc is divided already into special organ fields (e.g. an antenna field and a palpus field).

(That at the same time a duplicate formation of one and the same implant half can occur, might be a special case of that this developmental physiological appearance of the concerned organ after damage tends to form developmental doubles). Similar test results point that the latter could be due to a similar partitioning of the eye and leg disks into special organ fields with unequal distribution of the ocelli and/or claws duplications to the two implanted halves.

With the utilized test methods it is thus proven that in the early third larva stadium, it is not each imaginal disc in its whole, but only the individual organ fields contained in each, that are regulatable systems.

The different organ fields keep for a long time their ability to be regulated differently. Thus, at the end of the third larval stadium, duplication of the palpi, but not the arista, still occurs (Fig. 3).

Fig. 3. Palpal duplication (P) in a bisseted eye-antennal disc of a pupation ripe *D. hydei*-donor larva 6 days after implantation in an old larva. *A* eye, *M* maxilla. 80/1

3. Also, as already mentioned above, in some cases a widening of the arista axis occured that, perhaps, could to be considered as a first transformation of the arista into leg-like material."

The possible release here through a scission stimulus of "*homeotic regeneration*" is of special interest, because with *Drosophila* we have transformed the arista into a leg, through the gene mutation *aristopedia* (*ssa*). So far, those experimental transformations obtained resemble particularly arranged intermediate stages, as Finck[5]) found the *aristopedia* allele (ss^{a-4}) gives rise to a leg under certain breeding conditions. At the same time it is still emphasized that in view of my findings, the temperature sensitive period for ss^{a-4} falls into the first half of the third larval stage.

We have here thus again an example in which temperature-sensitive gene mutations and surgical intercessions intersect in their effect.

Only more experimentation will show whether we receive, by a further experimental analysis of the normal determination event in the imaginal discs, also one day an insight into the impact of those genetic mutations (and therefore also of their normal allele), such as *aristopedia* and also *probosipedia, terrapiera, bithorax, reduplicated,* and others, that in so remarkable a way intervene in the events of determination.

Neustadt i. Schwarzwald, Institt der Deutschen Hirnforschungsgesellschaft, den 6 November 1943.

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[1]) Nature (Lond.) 149 (1942).
[2]) Genetics 26 (1941).
[3]) Bull. Biol. Fr & Belg. 7 (1943)
[4]) J. exper. Zool. 87 (1941)
[5]) Biol. Zbl. 62 (1942).