A gene complex controlling segmentation in *Drosophila*

Edward B. Lewis

Nature, 7 December 1978

Edward B. Lewis

- Born in Wilkes-Barre, Pennsylvania May 20, 1918
- Began studying Drosophila in high school with Edward Novitski
- Began college at Bucknell and then transferred to University of Minnesota where he received a BA in Biostatistics in 1939
- Completed his PhD at Caltech in 1942 under A. H. Sturtevant
- Served as a meteorologist in the Air Force during WWII
- Returned to Caltech as an instructor and remained there until his retirement in 1988

Edward B. Lewis

- Awarded the Noble Prize in Physiology or Medicine in 1995 with Christiane Nüsslein-Volhard and Eric Wieschaus

review article

A gene complex controlling segmentation in *Drosophila*

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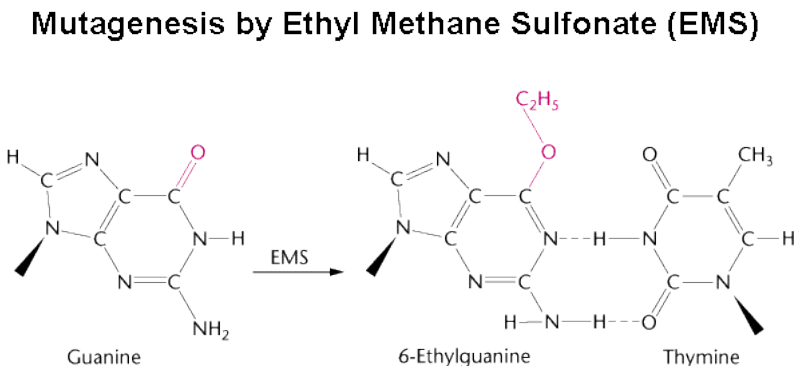
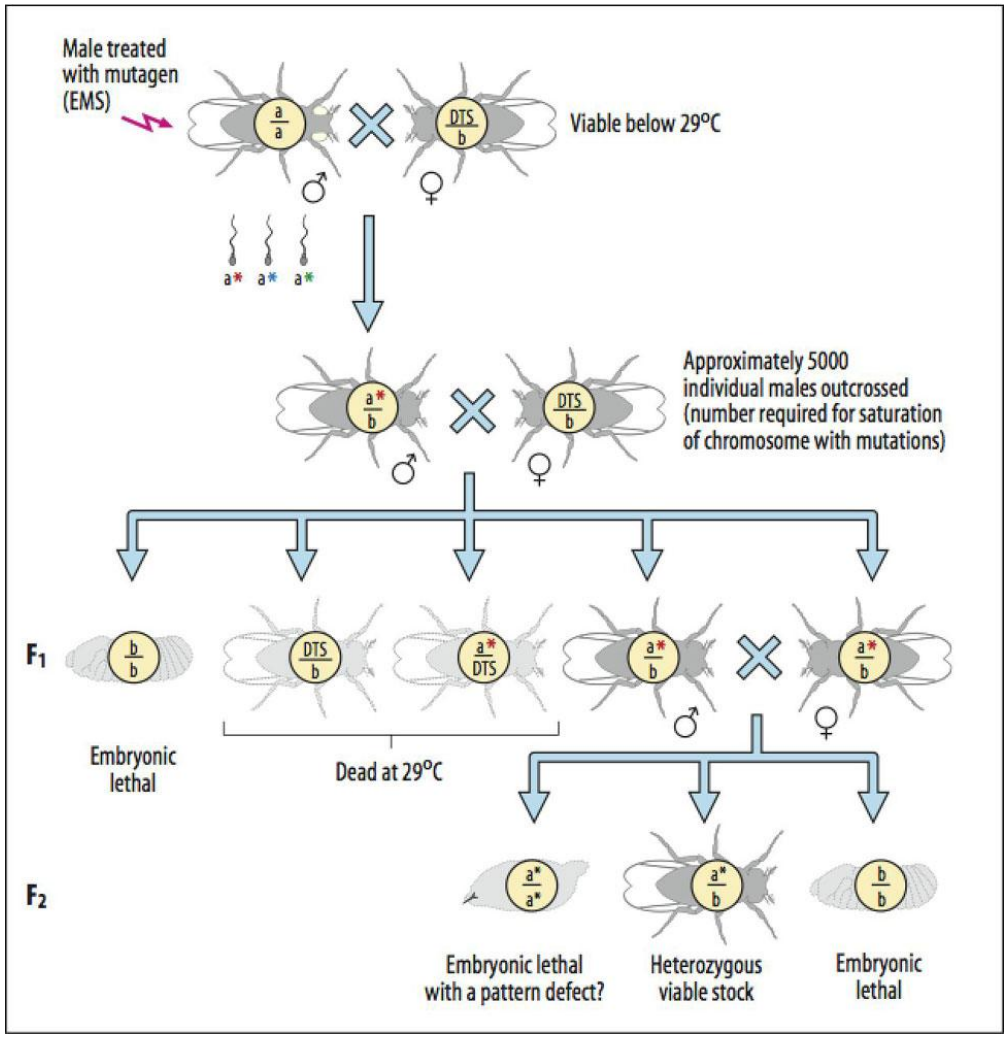
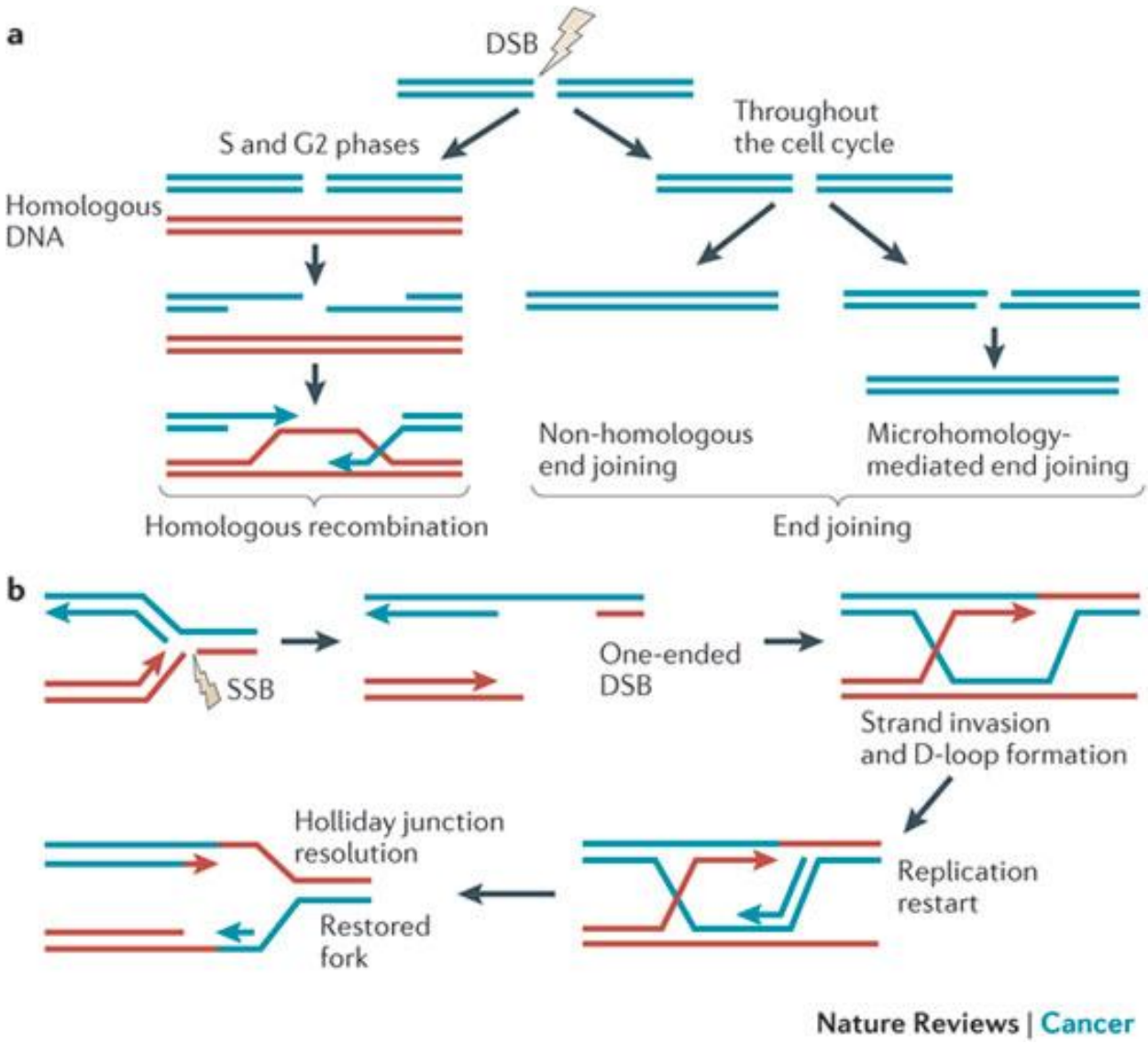
Mutagenesis in *Drosophila*: Ethyl methanesulfonate (EMS)



(Klug & Cummings 1997)



Mutagenesis in *Drosophila*: X-ray radiation

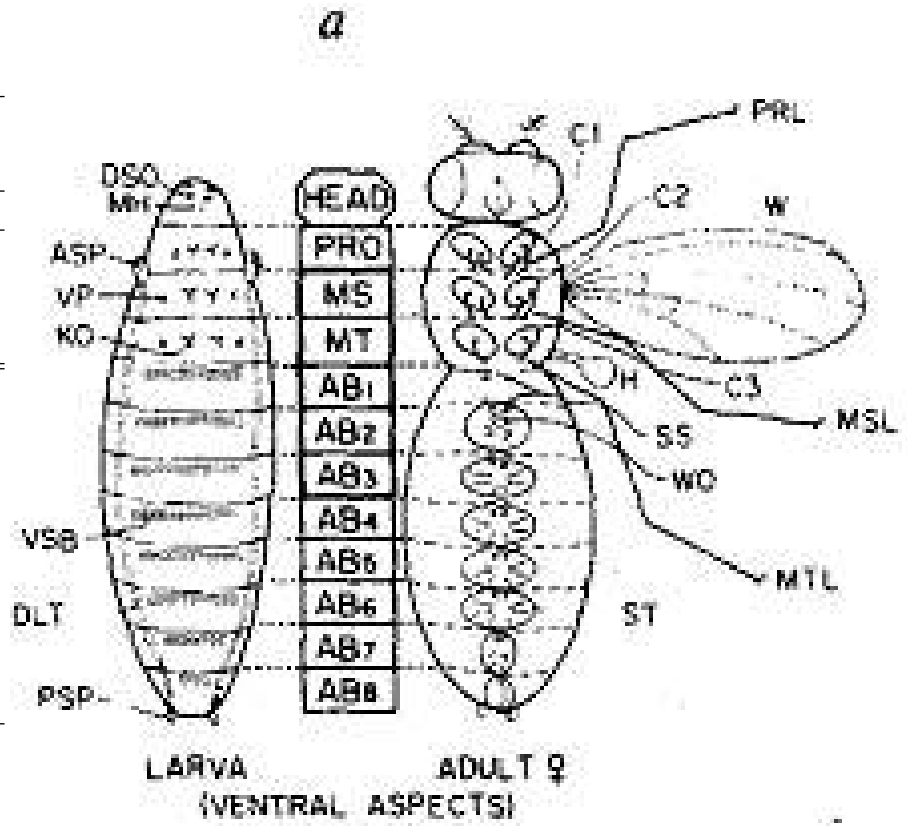


Anatomy of the fly (Figure 1)

Head

Thorax

Abdomen



ASP/PSP: Spiracles (exterior respiration organs)

VP: Ventral Pit

VSB: Ventral setal band

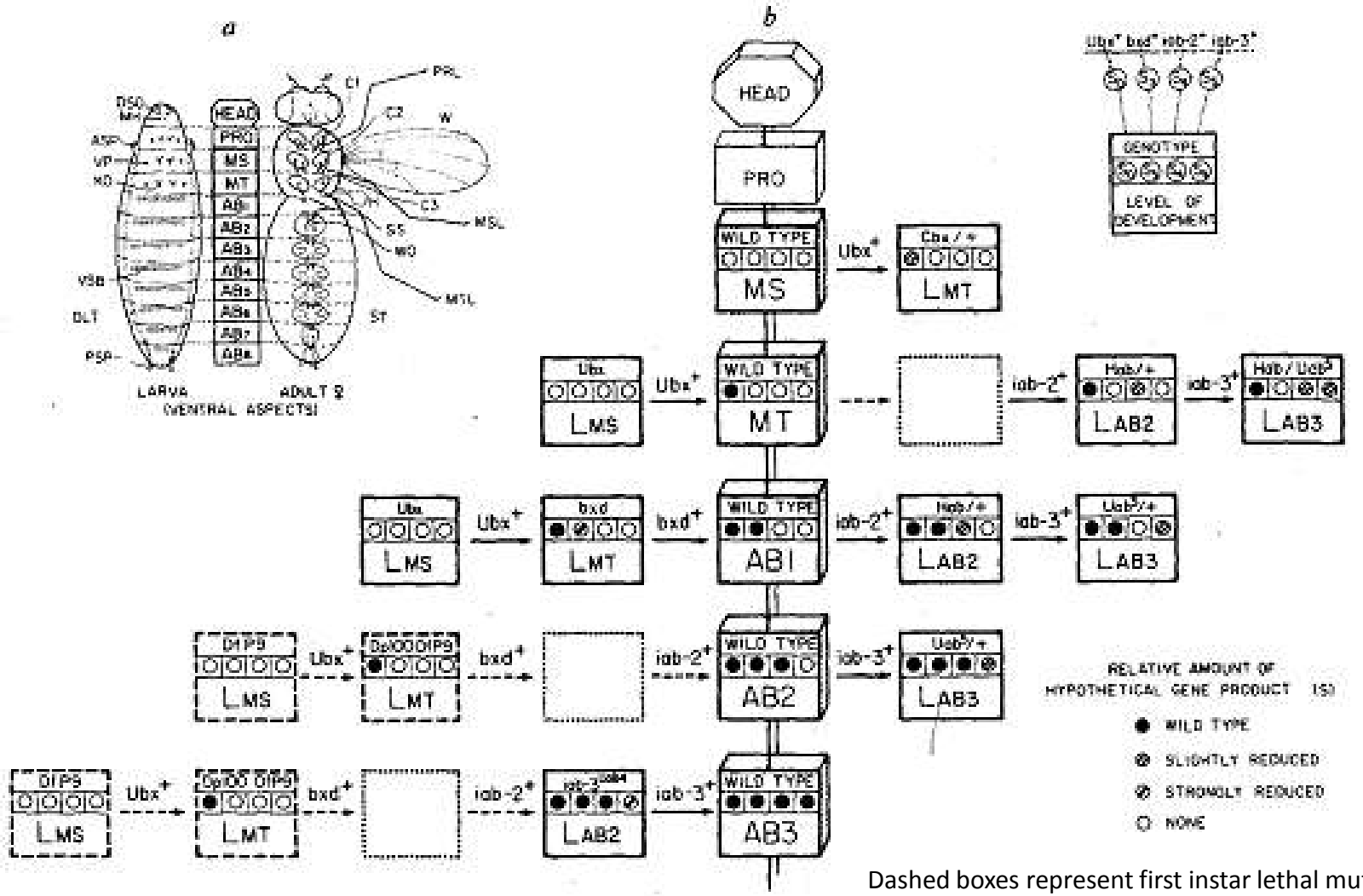
A cluster of genes controls segmental development (Table 1)

Table 1 Summary of the roles of BX-C substances (S) in controlling specific types of body segment transformations and specific structures in one or more segments of the larva

Gene	Substance	Segmental transformation
bx$^+$	S_1*	LAMS→LAMT
pbx$^+$	S_2	LPMS→LPMT
Ubx$^+$	S_0*	LMS→LMT
bxd$^+$	S_3	LMS→LAB1
iab-2$^+$	S_4	LMS→LAB2
iab-3$^+$	S_5	LAB2 or LMS→LAB3
iab-5$^+$	S_7	LAB4 or LMS→LAB5
iab-8$^+$	S_x	LAB7 or LMS→LAB8

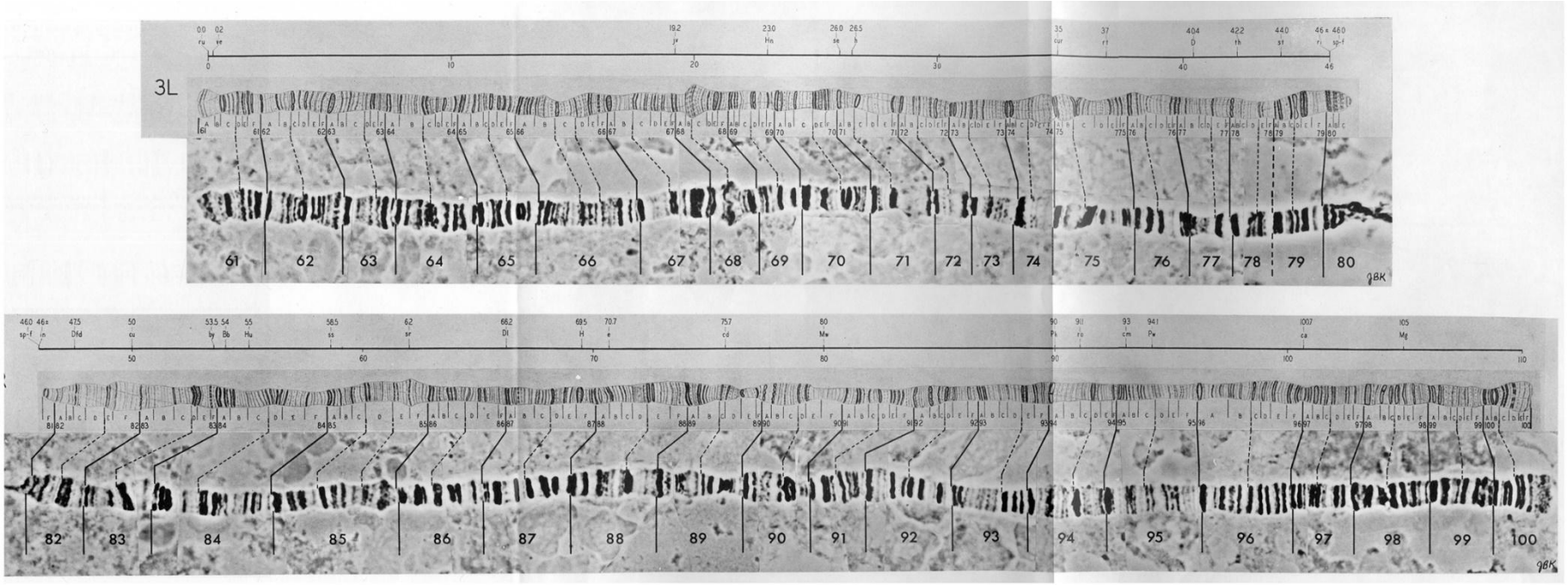
* Substance, S_1, was originally postulated to be coded for by either *bx*$^+$ or *Ubx*$^+$ (ref. 4); in this article S_1 is assigned to *bx*$^+$ and S_0 to *Ubx*$^+$.
† Comparison of genotype *e* and *f* indicates that *bxd*$^+$ and/or *iab-2*$^+$ may be responsible for the continuity of dorsal tracheal trunk in AB1.
‡ Suppression of VP and KO may result from the presence of *iab-8*$^+$ and/or one or more *iab* genes located between *iab-3* and *iab-8*.

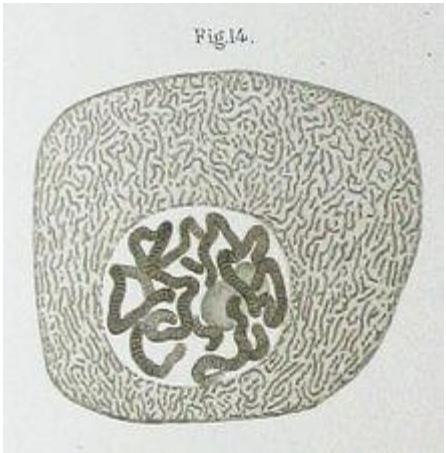
Segmentation control of the fly (Figure 1)



Dashed boxes represent first instar lethal mutations

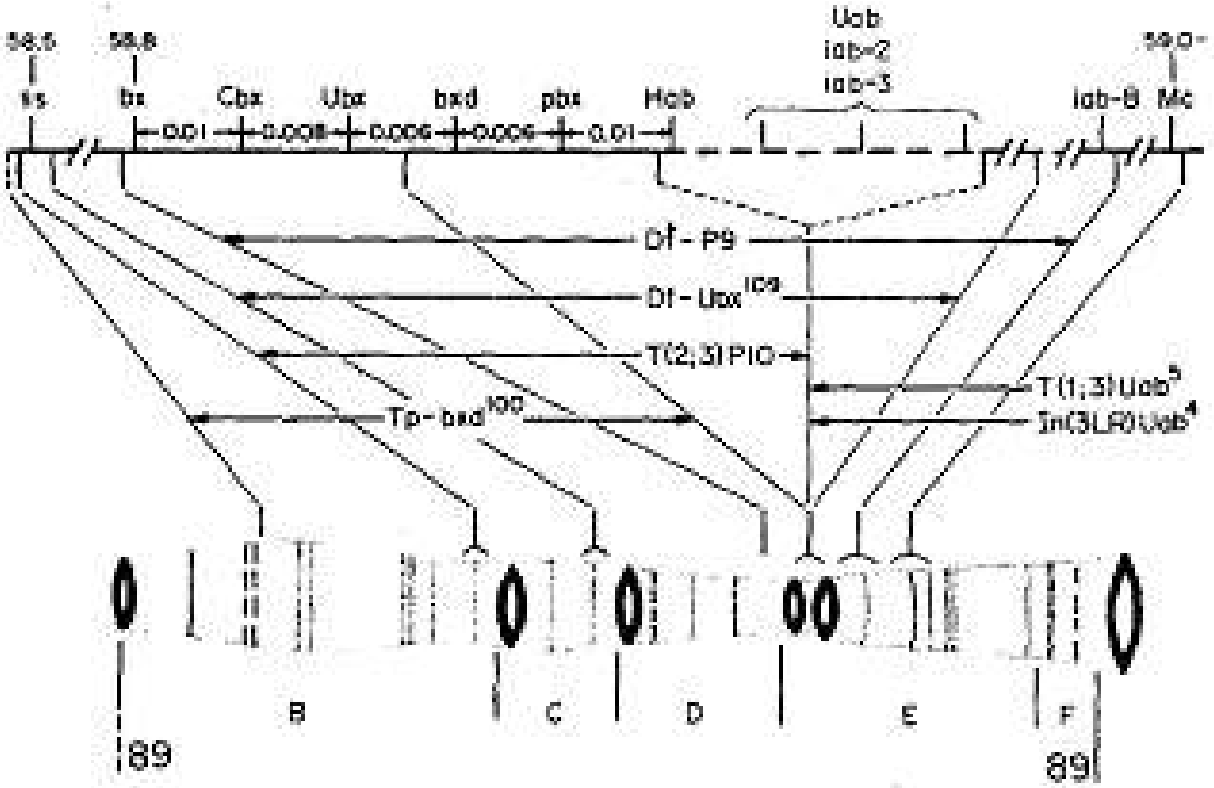
Using salivary gland chromosomes to analyze rearrangements





Calvine B. Bridges extensively mapped polytene chromosomes in 1935 that allowed for rearrangements and mutations to be indentified

Using chromosome analysis, BX-C genes are mapped (Figure 2)



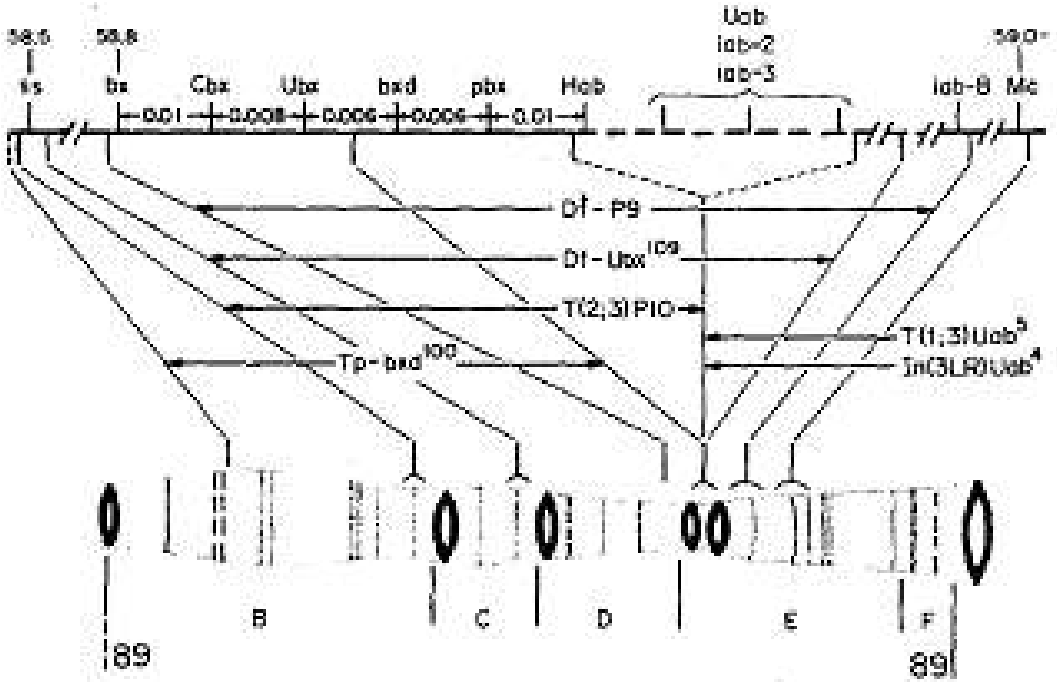
D: Duplication

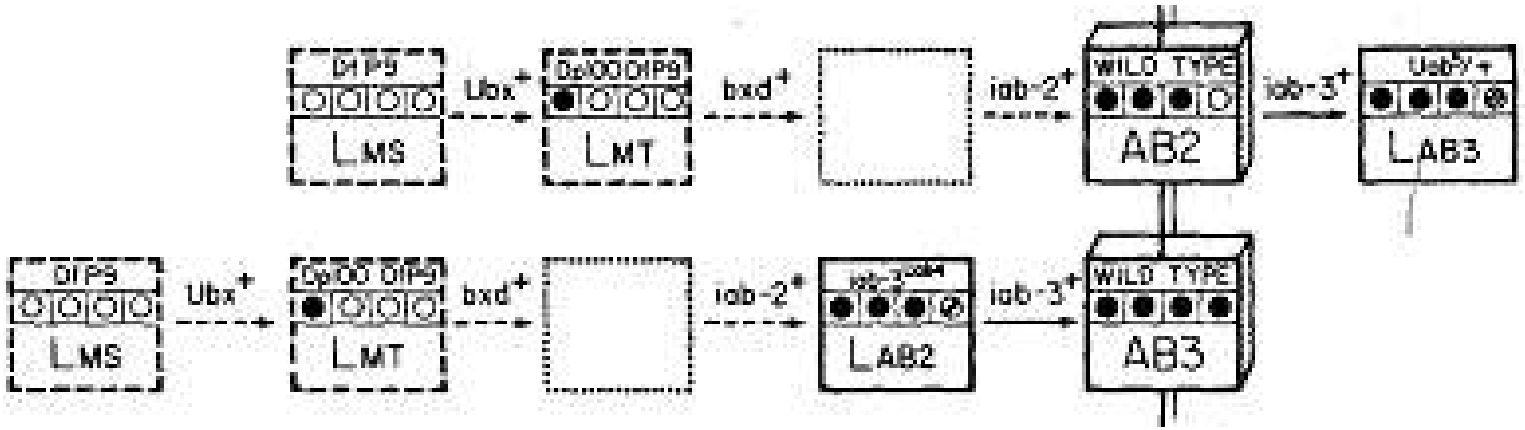
T: Translocation

Tp: Transposition

In: Inversion

Effects of Df-P9

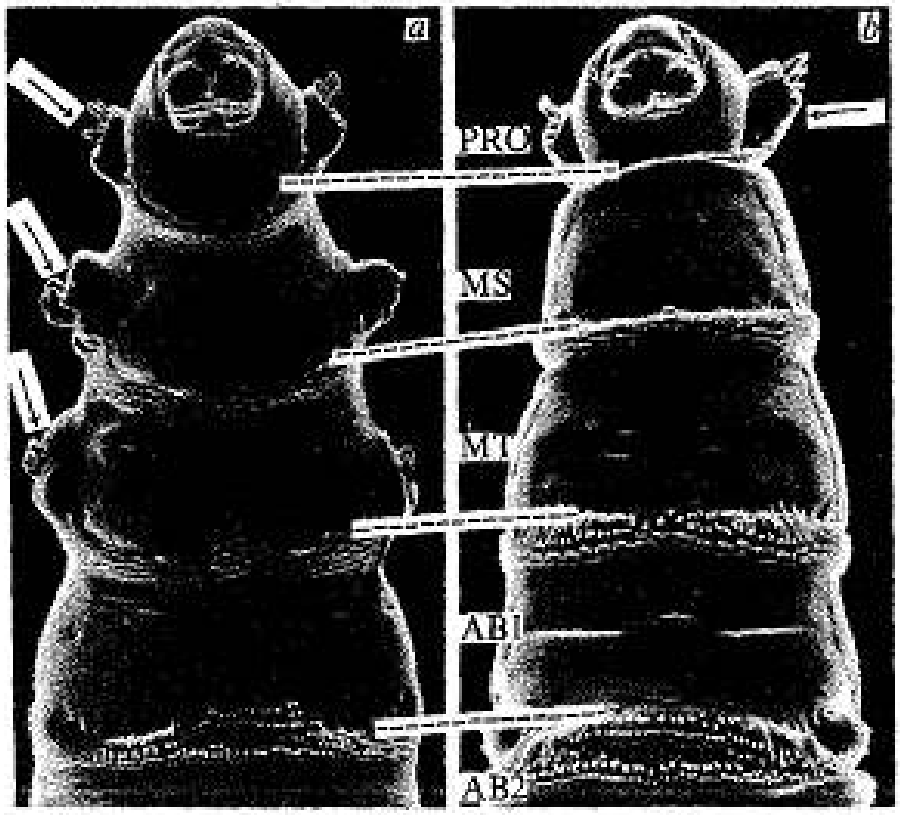




Loss of function phenotypes (Figure 3)

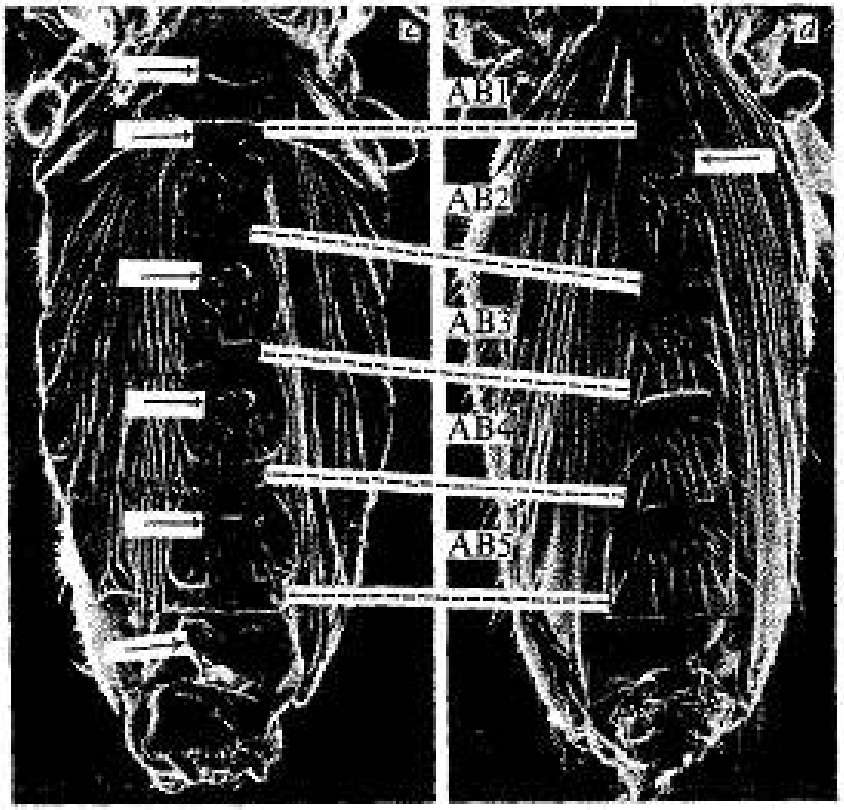
Df-P9 mutant

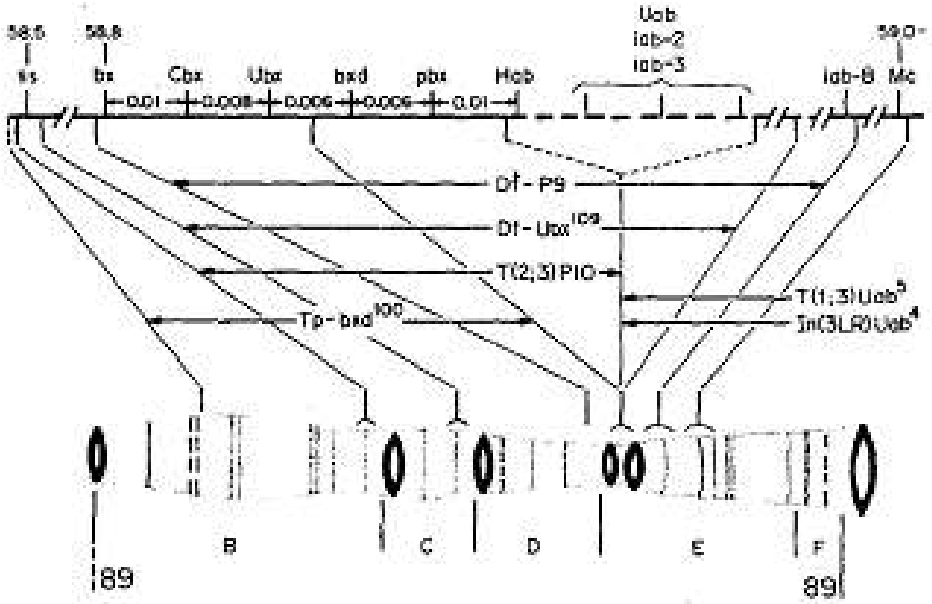
WT



Loss of function phenotypes (Figure 3)

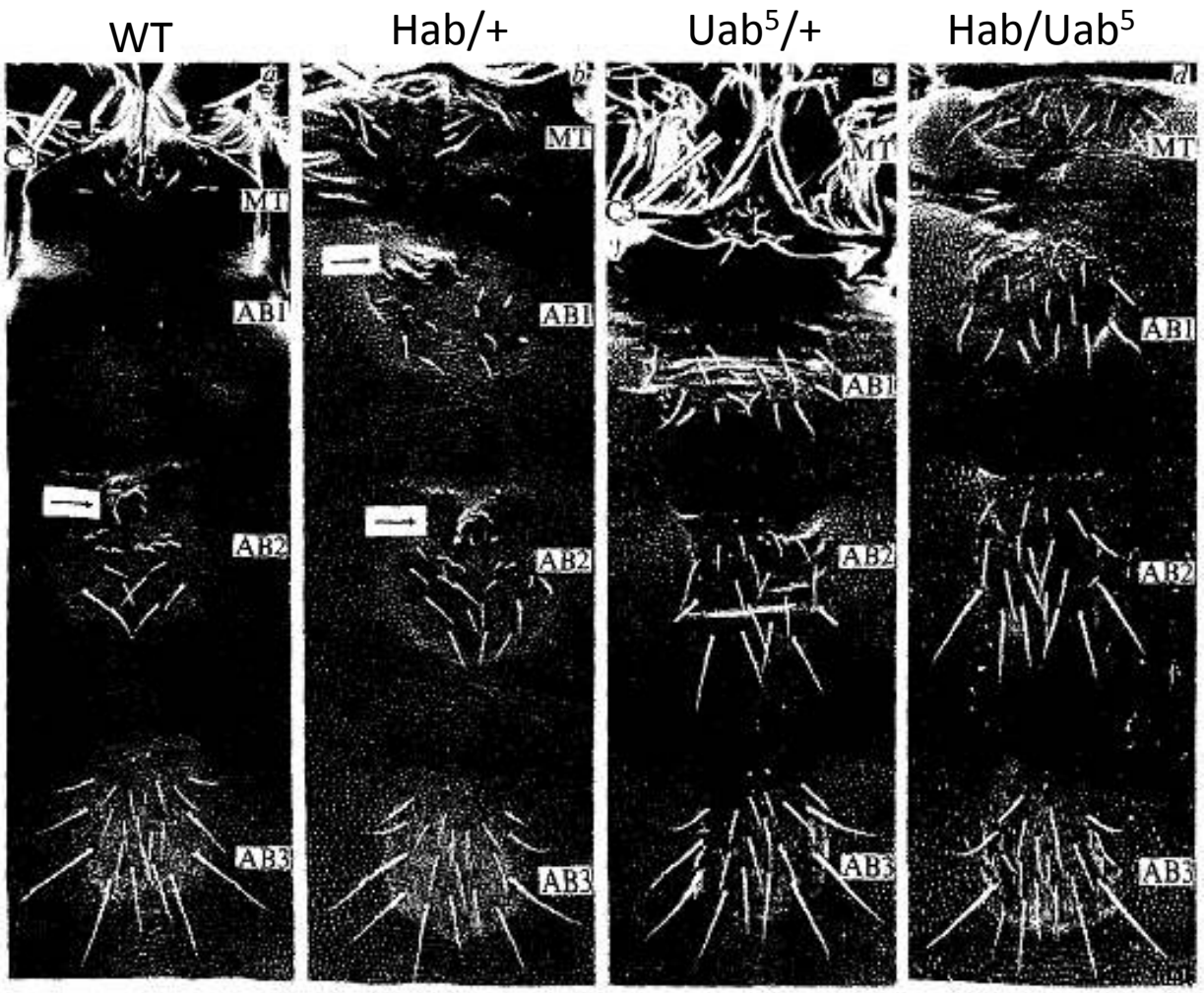
In(3LR)Uab^4 WT

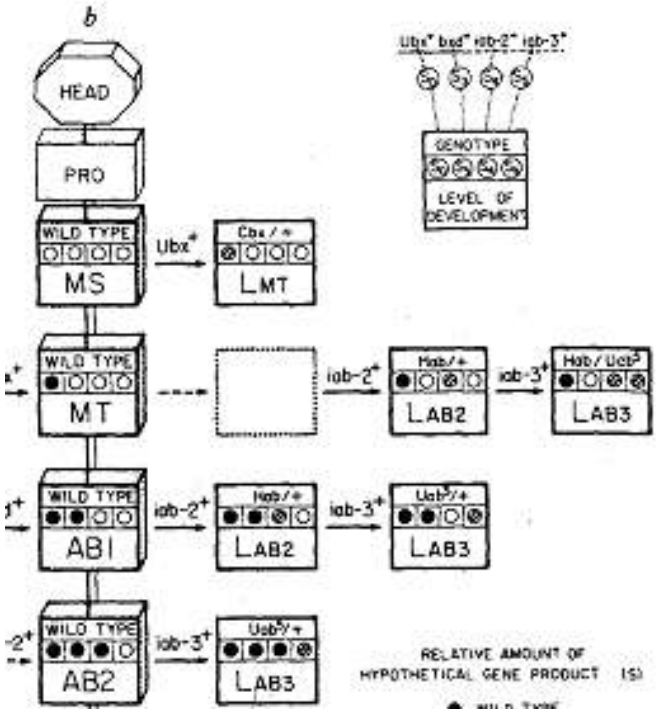




Arrows indicate Wheeler's Organ (WO)

Gain of function phenotypes (Figure 4)



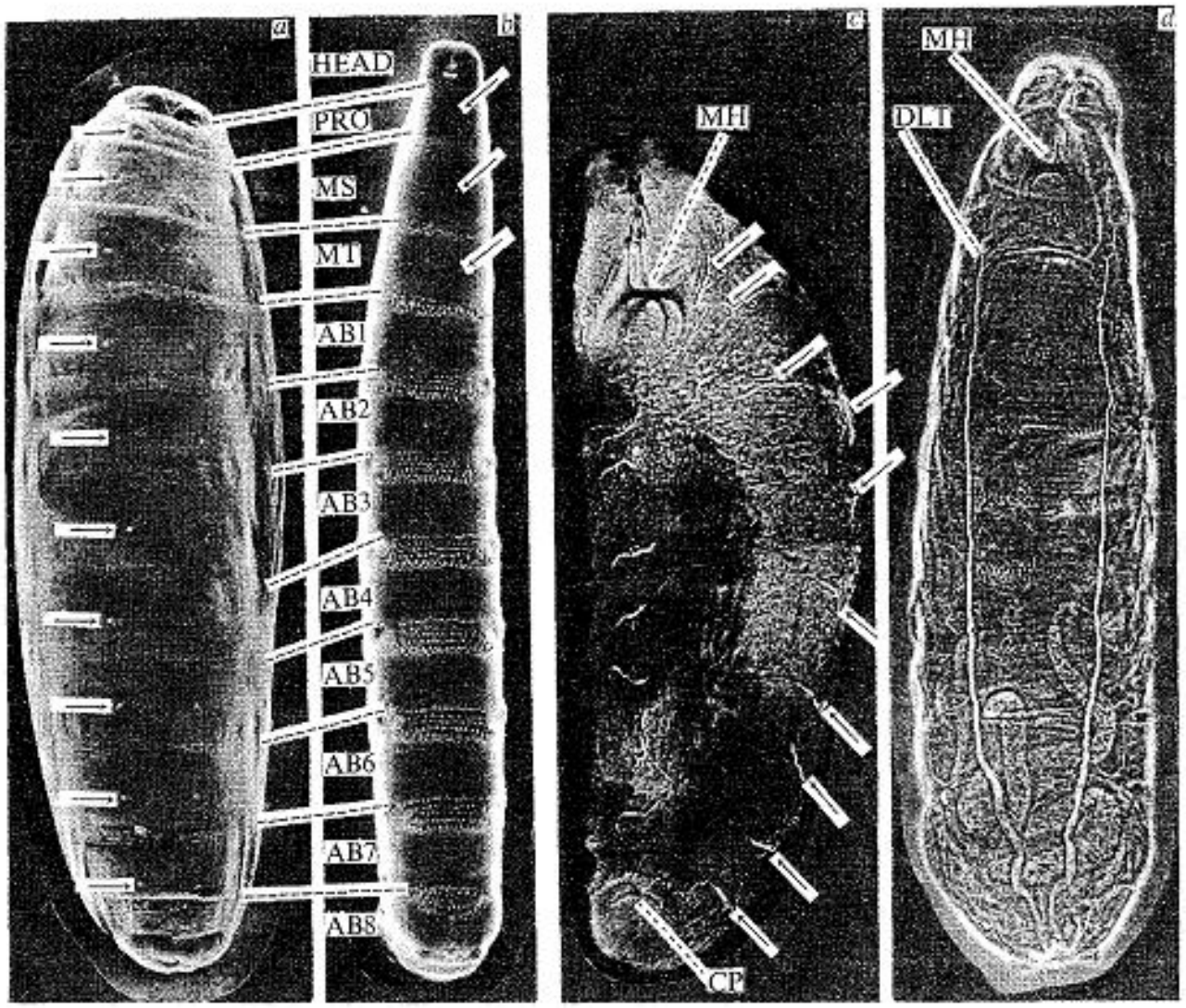


Hab: Increased iab-2 expression

Uab^5: Increased iab-3 expression

Larval analysis of Df-P9

Df-P9 Wt Df-P9 Wt

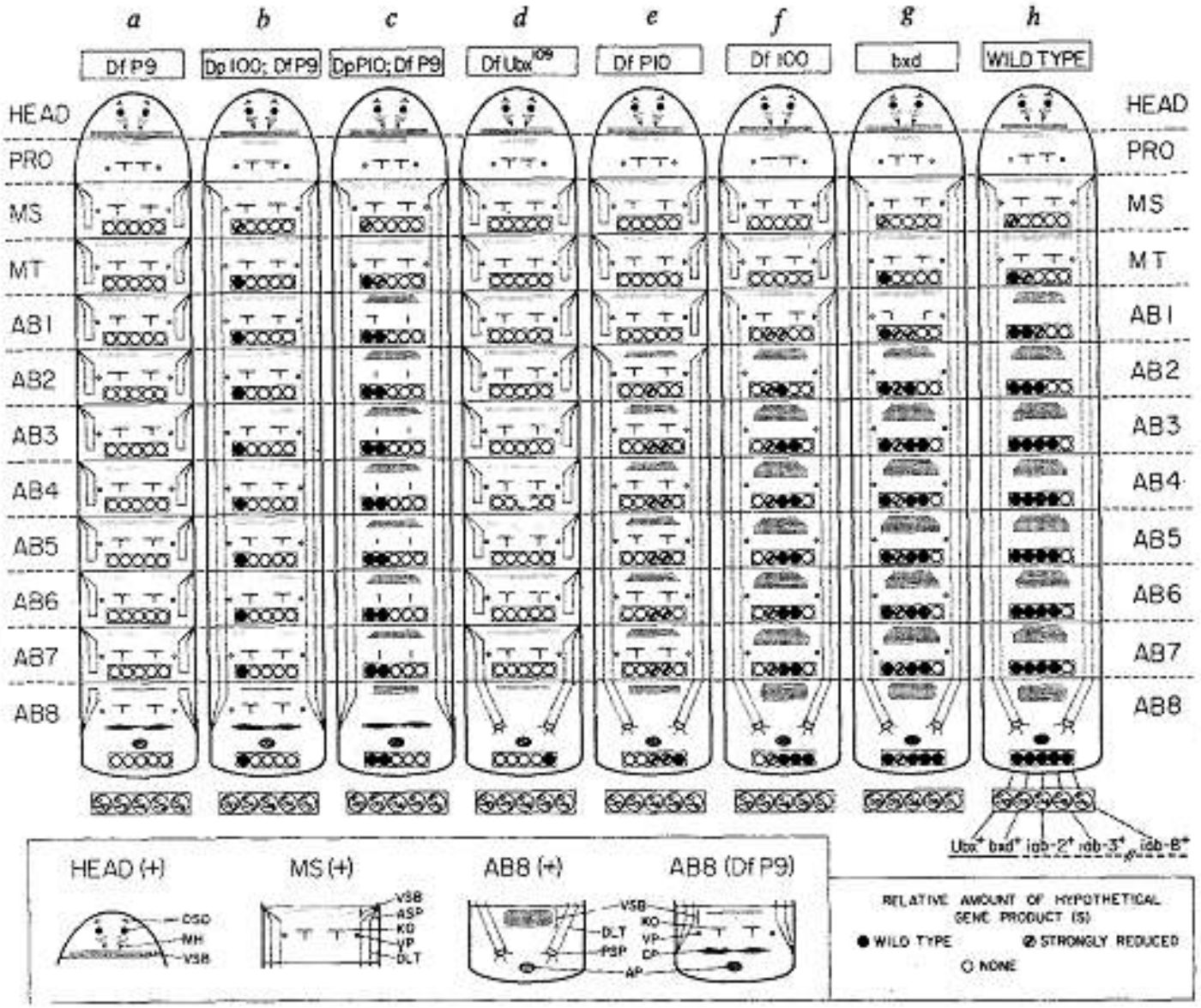


Cutical segments

Arrows indicate Keilin's organs

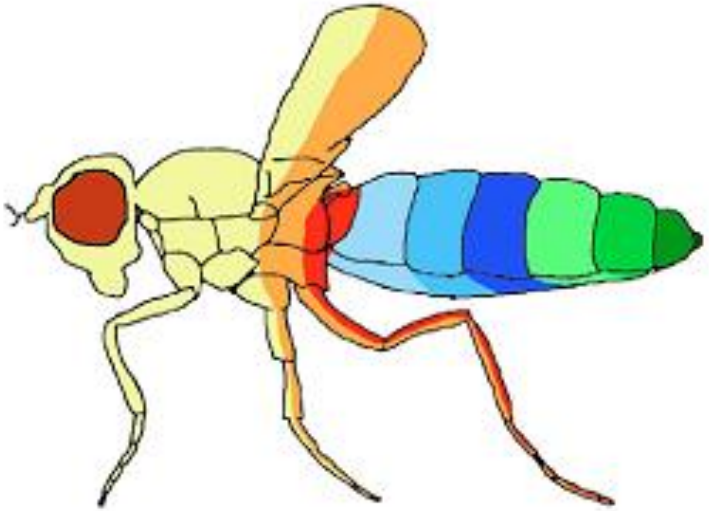
DLT: Tracheal tract

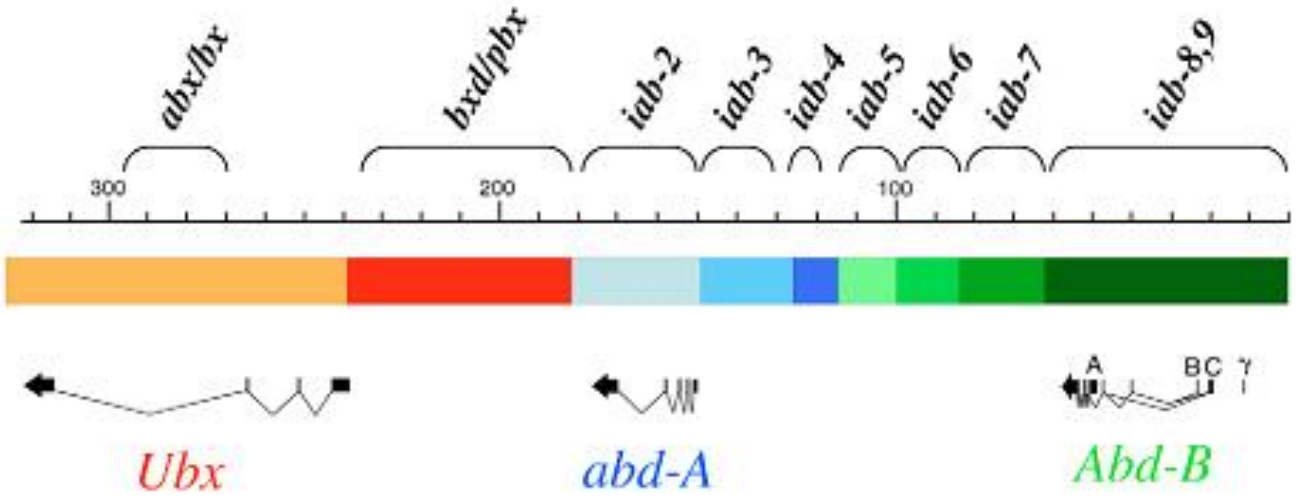
Summary of 40 years of mutant analysis



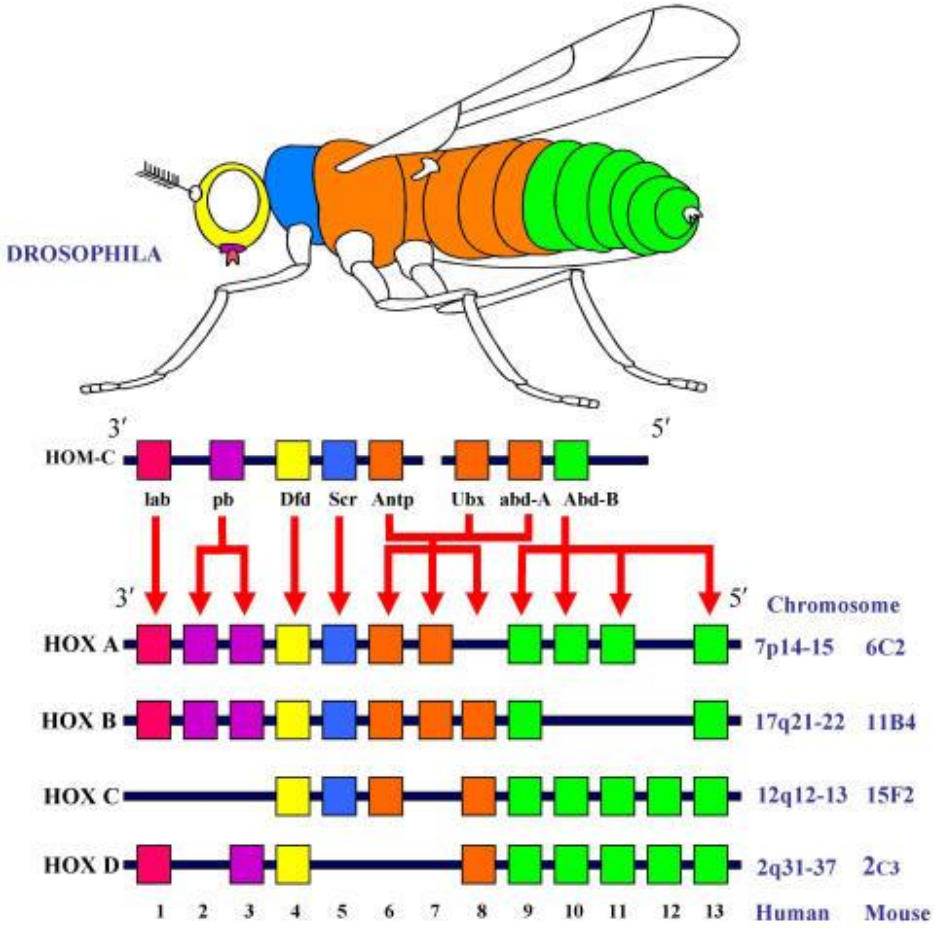
Mastering the manipulation of BX-C

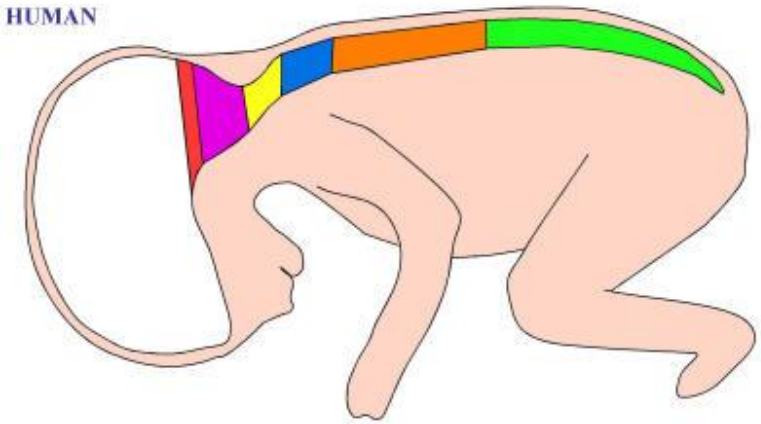
What we know about the BX-C





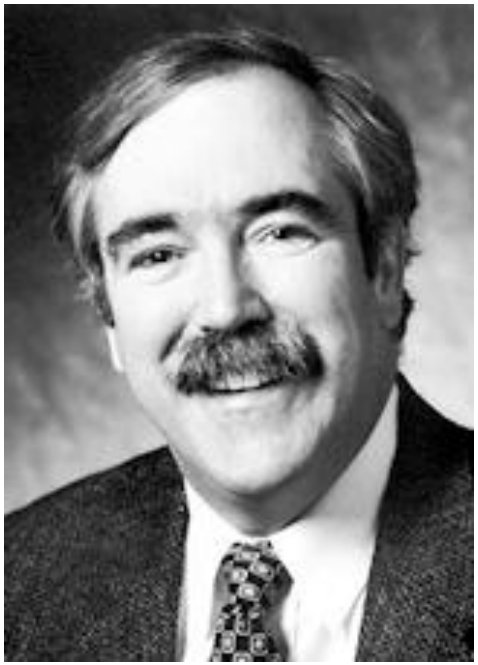
Maeda and Karch. Development (2006).


DROSOPHILA
3′
5′
HOM-C
lab
pb
Dfd
Scr
Antp
Ubx
abd-A
Abd-B
3′
5′
Chromosome
HOX A
7p14-15
6C2
HOX B
17q21-22
11B4
HOX C
12q12-13
15F2
HOX D
2q31-37
2C3
1 2 3 4 5 6 7 8 9 10 11 12 13
Human
Mouse


HUMAN

Next class: Segment number and Polarity

Christiane Nüsslein-Volhard



Eric Wieschaus