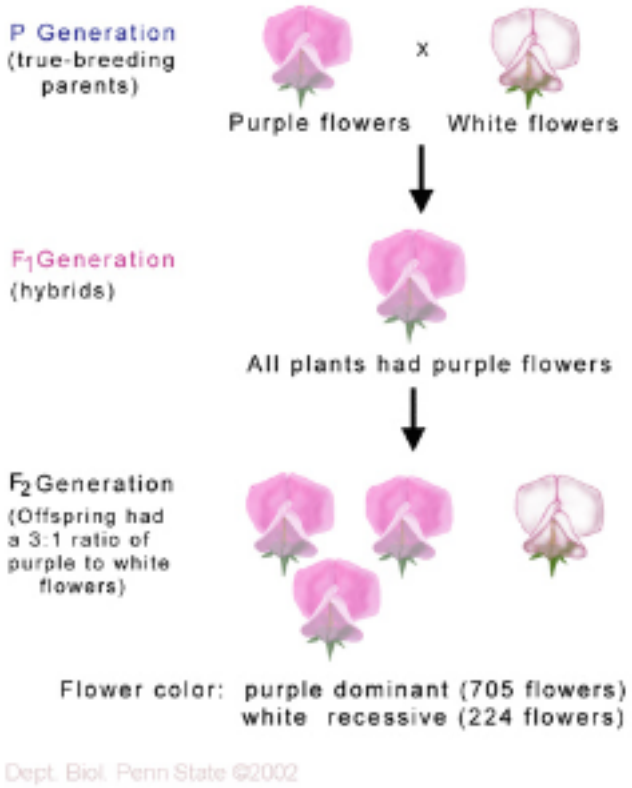
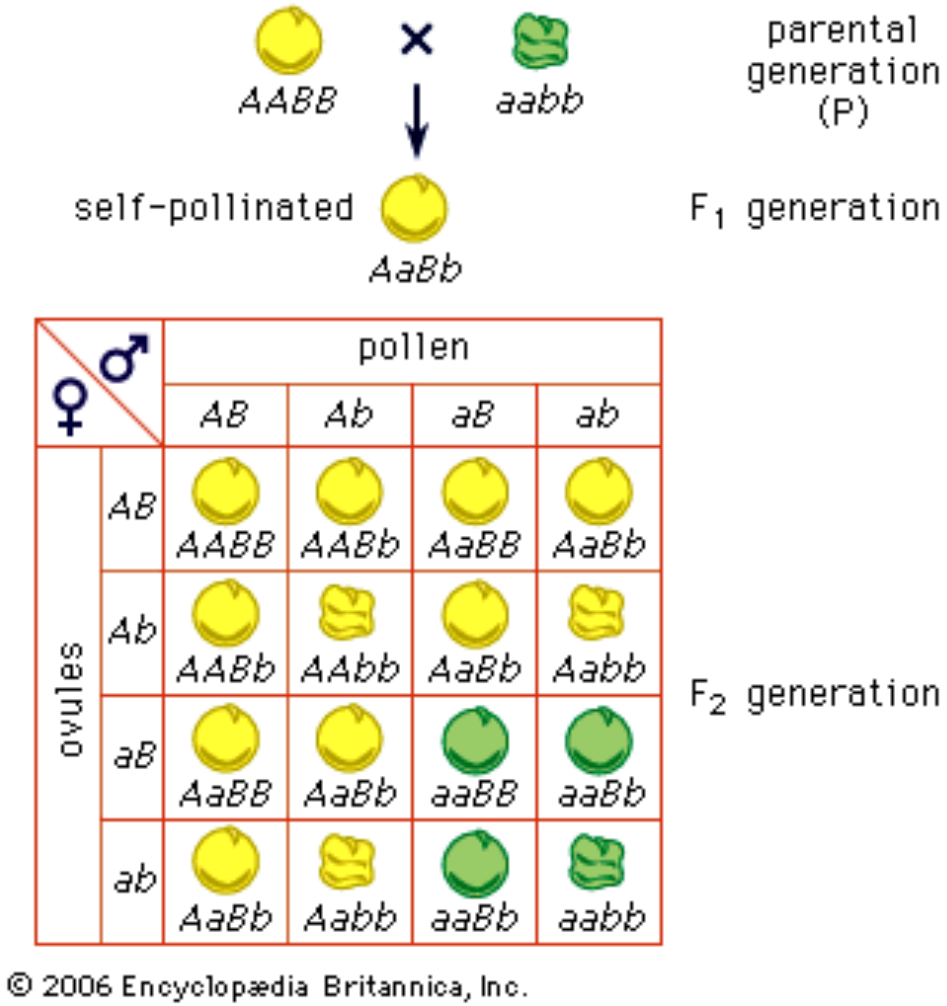
Physical Basis of Genetic Material

Anirvan Sengupta

Mendel's Work (mid-1800)



Independent Assortment vs Linkage



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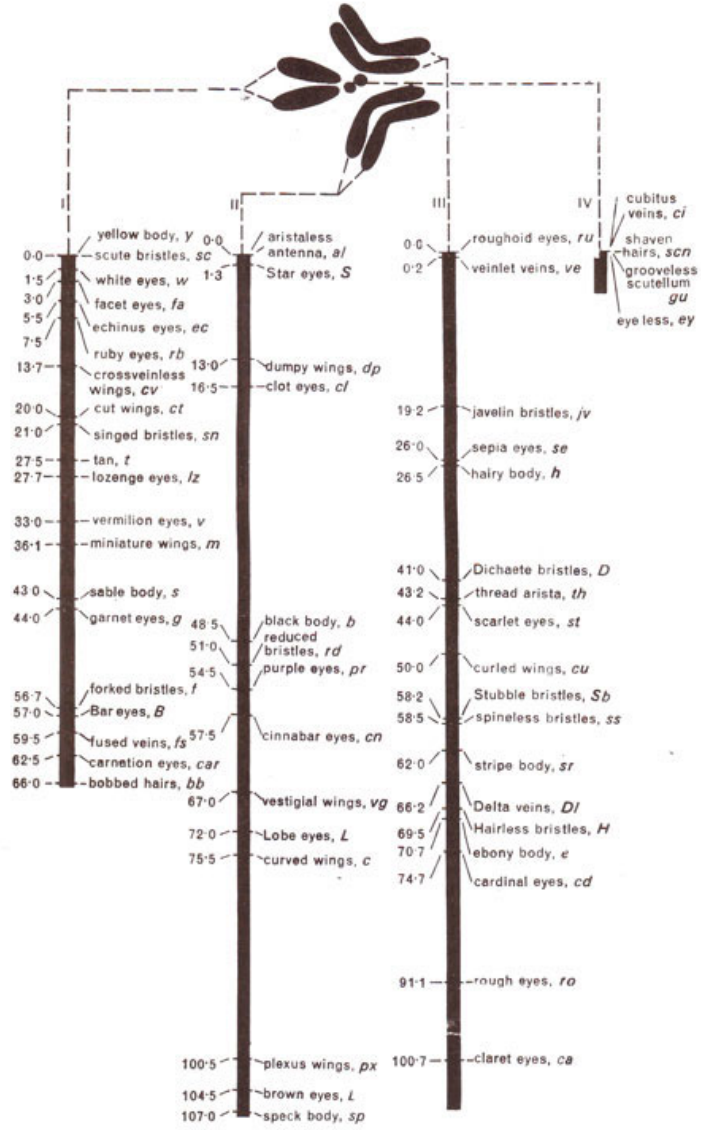
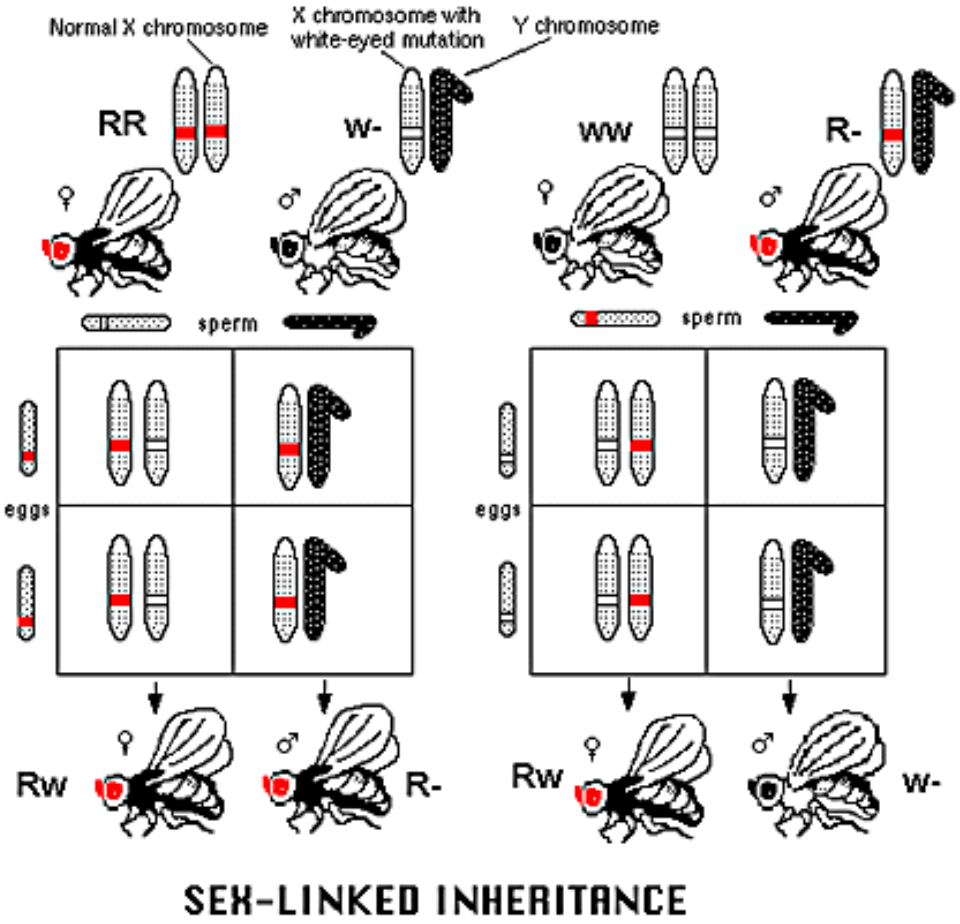
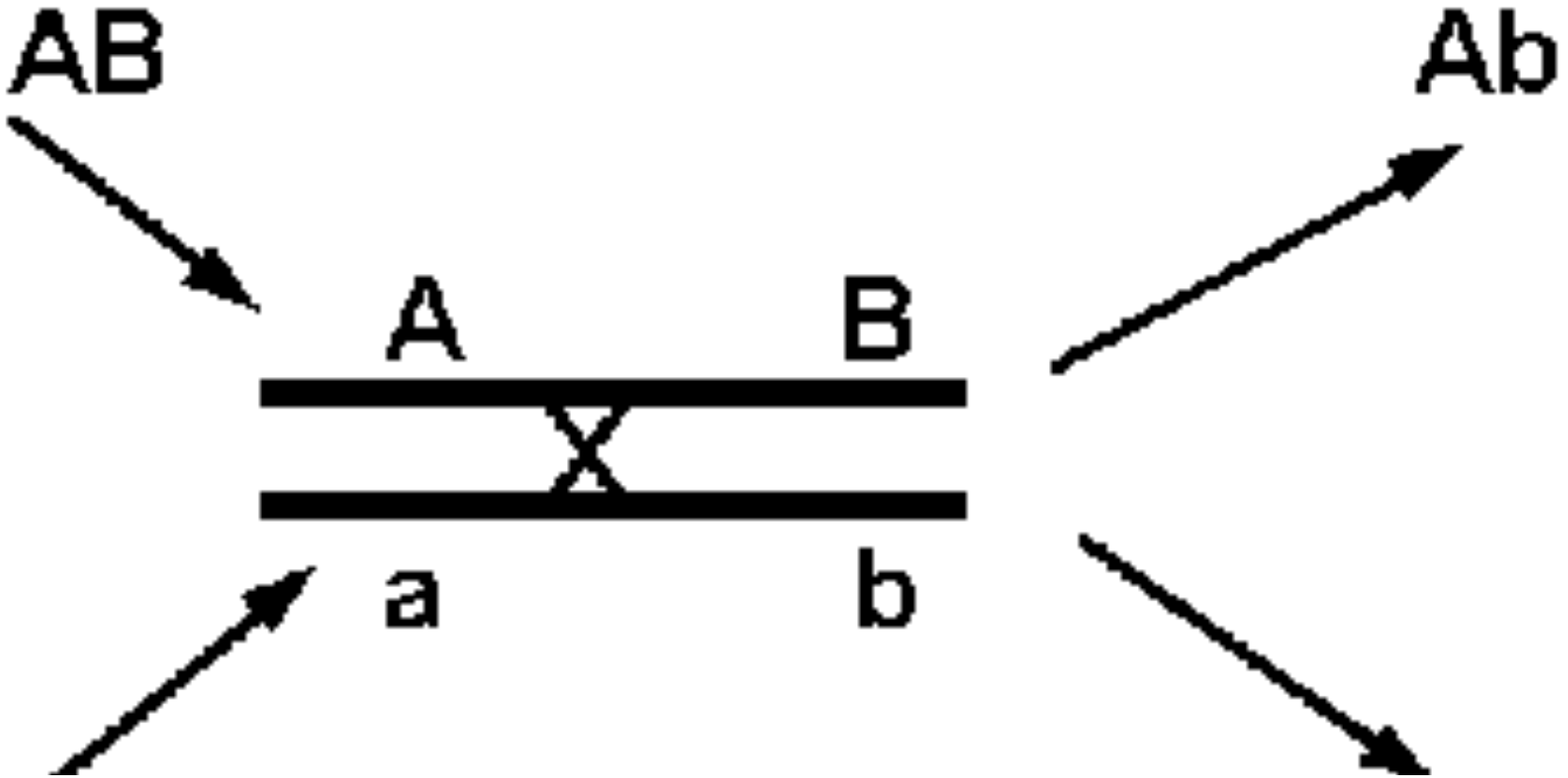
Morgan and Linkage (early 1900's)



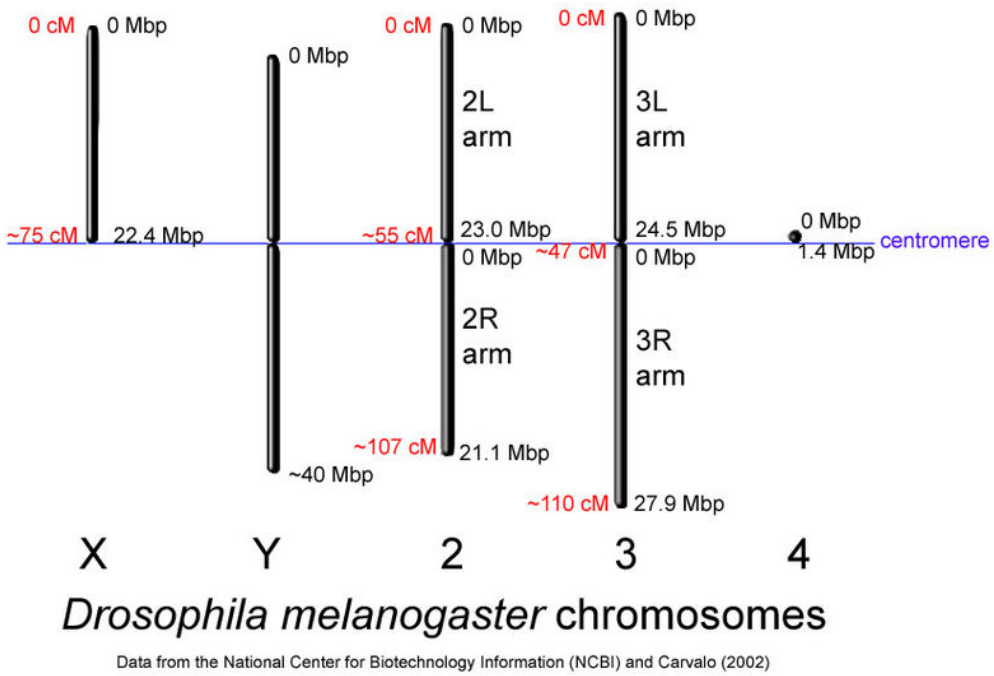
Sex-linked

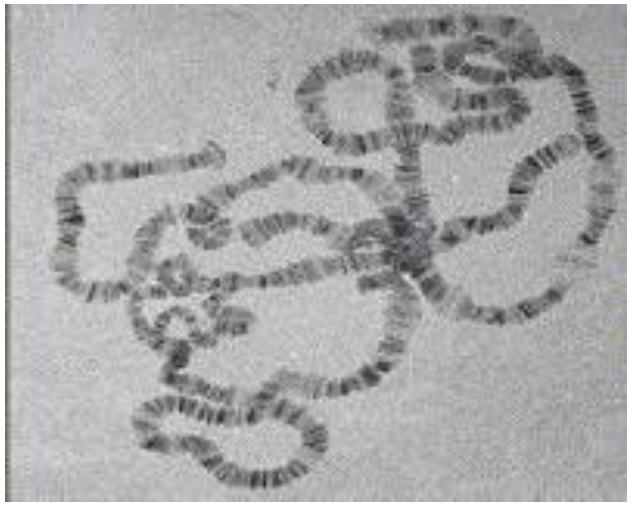

Normal X chromosome
X chromosome with white-eyed mutation
Y chromosome
RR
W-
WW
R-
sperm
sperm
eggs
eggs
Rw
R-
Rw
W-
SEX-LINKED INHERITANCE

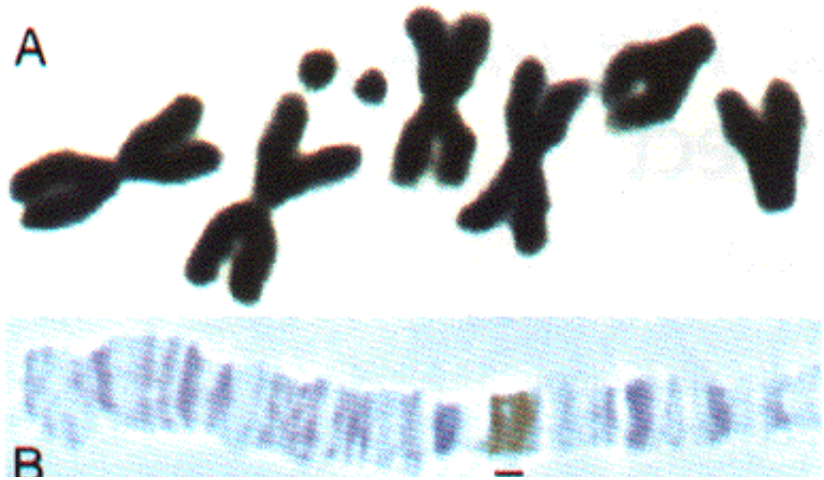
Recombination and Linkage Disequilibrium



Chromosomes (Mitotic, Polytene)





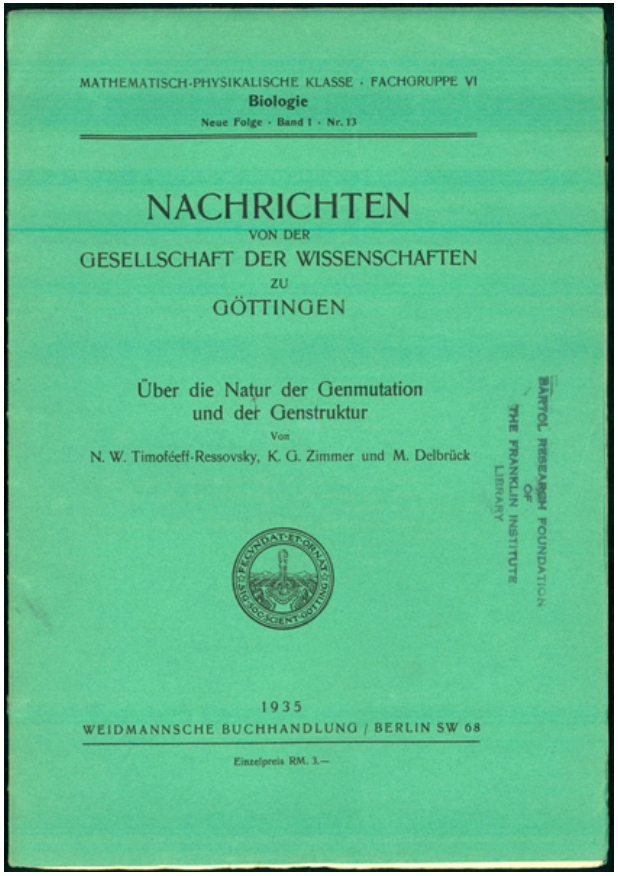


Mitotic chromosomes width 0.25µm length 2µm
Polytene chromosomes length 200µm

Estimated upper bound on gene size: 0.025µm

Muller (1920's): Xrays and Mutation

Berlin gang: The three-man paper (1935)

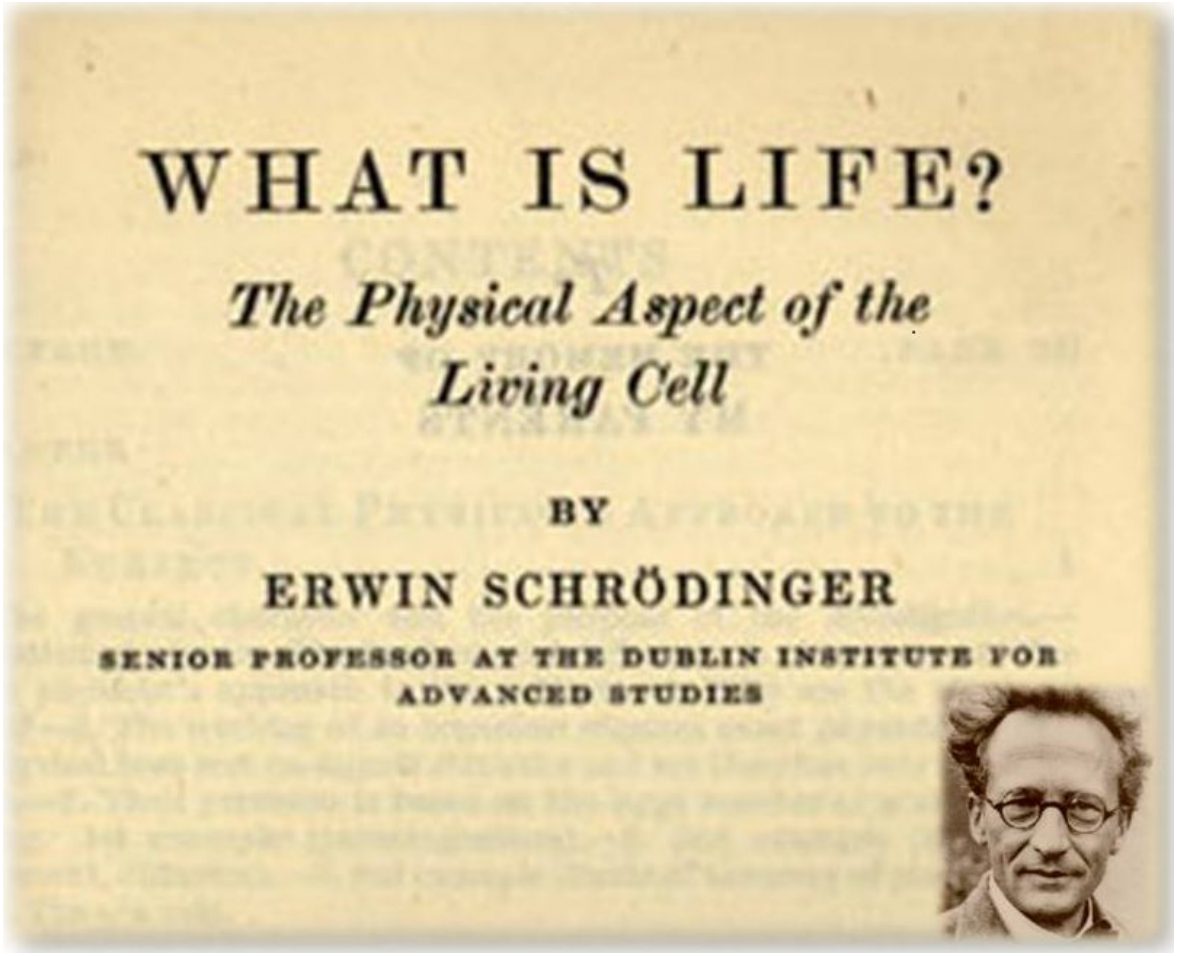


Timofeeff-Ressovsky, Zimmer and Delbruck

Essential point

- Mutation rate increases linearly with ionizing radiation
- Makes sense if the mutations are caused by ‘single molecule’ events
- Mutation rate= $P_1 c^* v = P_1 Kc_{ion} v$

‘What is life?’ (1944)



Bond energy/k_BT
=50-60

Stability of heredity from Quantum Mechanics!