

Somatic evolution

sperm/egg (bottle neck) some parental alleles lost

DNA synthesis / division (introduction of new mutations)

differentiation - expression of some genes not others

number of cell divisions in human life span

about 3×10^{13} cells in the body

10^{16} cell divisions
(many associated with red blood cells)

each cell division, 6×10^9 base pairs replicated

mutation rate $\sim 2 \times 10^{-8}$ per replicated base pair

<http://bionumbers.hms.harvard.edu/bionumber.aspx?id=100379>

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Somatic evolution

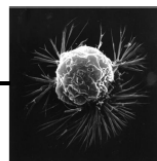
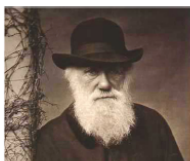
BMC Biology

REVIEW

Open Access

Nothing in cancer makes sense except...

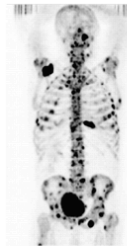
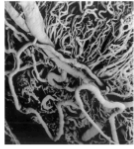
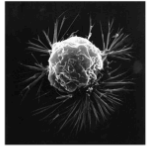
Mel Greaves



Evolutionary logic
of vulnerability to
cancer

Cancer clone
progression by
natural selection in
tissue ecosystems

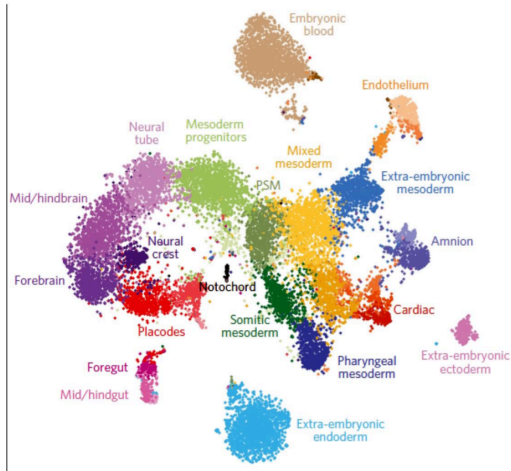
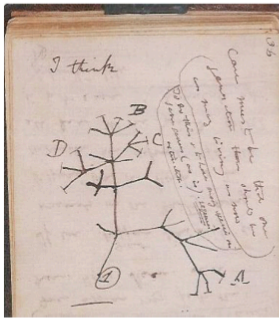
Emergence of drug
resistant variants
under the selective
pressure of therapy



Metastases
Drug resistant

1 mutant cell \longrightarrow $\sim 10^{11}$
Time: \longrightarrow months / decades \longrightarrow
 \longrightarrow covert \longrightarrow

Charles Darwin, 1837, Notebook B



Gene expression analysis identified 20 general cell types (in 33 different clusters, indicated by the different colors) in the 8 day mouse embryo. Clusters was identified based on the expression of marker genes. Several cell types are composed of two or more clusters. adapted from Ibarra-Soria et al., 2018