Part 5 Murder or Suicide The troubled birth of the individual

> unicellular multicellular: independent (colony), dependent (differentiated) individual



Natural selection upon genes, individuals, groups of individuals, species?

Species level might be plausible rather than individual Ageing: what do we gain from getting old and dying? sex: twice as costly as clonal reproduction genetic variation (meiosis)



If sex evolved in a species any possibility of tentative sex before being fully developed?

The unit of selection: cell or gene?

In multicellular organisms Only the genes, not individuals, are transferred to the next generation Inclusive fitness: altruism at the level of genes selfish gene living organisms are throwaway survival machines of their genes disposable soma theory

In asexual reproduction: individual cells are transferred In sexual reproduction: individuals are not transferred Body is the product of genes collaborating together to serve their own selfish end of being copied in ever greater numbers



What is their purpose?

Genes (in a cell) & Cells (in a body): reproduction



11. Conflict in the body

Cancer (out of control)



Apoptosis

Apoptosis in unicellular eukaryotes? yeast Apoptosis in the first eukaryotes? The history of apoptosis

Apoptosis & Necrosis Extrinsic & Intrinsic pathway: caspase cascade Apoptosis & mitochondria: membrane depolarization, ROS Mitochondria & cell connection: Cytochrome c & other proteins Permeability transition pore (mPTP) bcl-2 family proteins: anti-apoptosis & pro-apoptosis

The central role of mitochondria in apoptosis Mitochondria brought with them the death machinary Mitochondrial origin of apoptosis proteins most of the proteins released from mito caspases bcl-2 family proteins

Apoptosis is not a suicide but a murder from inside

Evolutionary origin of apoptosis



Can be applied to the first eukaryotes But contradictory to the symbiosis of a peaceful metabolic cooperation (hydrogen hypothesis) 12. Foundations of individual

Parasite war & hydrogen hypotheses Which is correct?

Bacterial porins: where did they come from? if parasite model is correct, they might share evolutionary origin with bcl proteins

bcl proteins & bacterial porins: structural similarity but not genetic probably the result of convergent evolution? bcl proteins from α-proteobacteria? insufficient sequence data bacterial porins from mitochondria (from the eukaryotic host)?

 \Rightarrow Not enough information, but probably does not support parasite model

Based on Hydrogen hypothesis



Sex and the origin of death

Neil Blackstone & Douglas Green, 1999



The role of ROS in sex



Yeast, Volvox: mating gene activation upon ROS increase

First step to the individual How sex turned into death?

Sex means genetic recombination to replace or mask damaged copy Free radical in bacteria stimulate lateral gene transfer

Apoptosis: repair of damaged cells in a body (cost effective than fixing) Similar to modern 'throwaway' culture

Blackstone

hydroid (asexual & sexual reproduction) cellular colony differentiated cells (a cellular 'caste' system): controlled by their redox state

