CLADOGRAM OF PROTOZOA RELATIONSHIPS

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CLADOGRAM OF PROTOZOA RELATIONSHIPS

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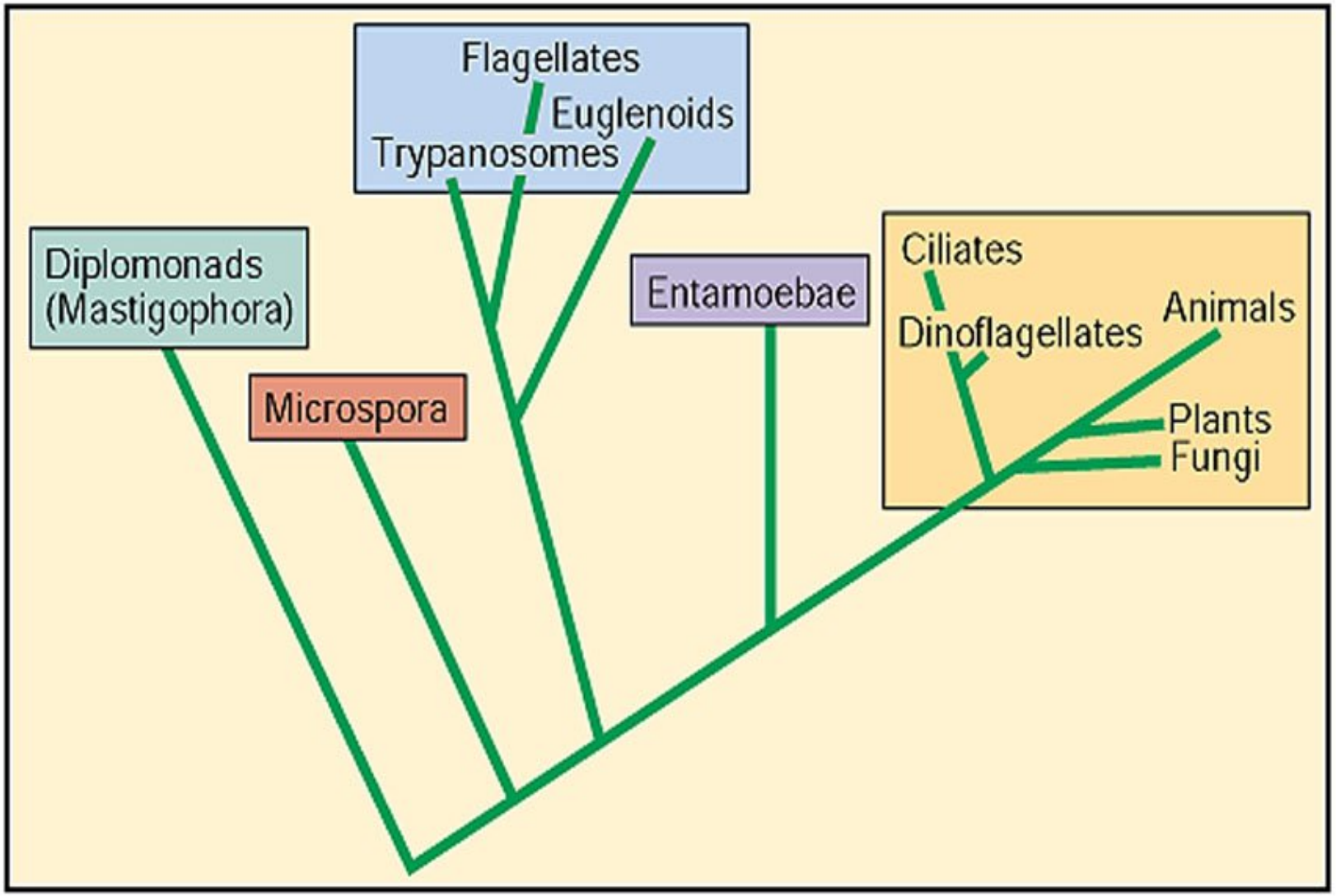

Flagellates
Euglenoids
Trypanosomes
Diplomonads
(Mastigophora)
Microspora
Entamoebae
Ciliates
Dinoflagellates
Animals
Plants
Fungi

ENDOSYMBIOSIS AND CYTOPLASMIC INHERITANCE IN PARAMECIUM

THIS TOPIC WILL FOCUS ON THE FOLLOWING :

Altenburg paper (1948)
- –Plasmagene hypothesis
- –Kappa body symbiosis

Current understanding of Kappa bodies (Preer 1974)

Paramecium biology
- –Cell biology
- –Life cycle

Other cytoplasmic inheritance in *Paramecium* (Meyer 2002)

ALTENBURG PAPER (1948) INVESTIGATES THE EVIDENCE THAT KAPPA BODIES ARE A SYMBIONT

- ***Kappa bodies are elements within Paramecium that cause them to be killers***

- ***Killer Paramecium kill other Paramecium in the immediate environment***

- ***Kappa particles, thought to be plasmagenes by Sonneborn, but Altenburg suggest they may be symbionts***

THE PLASMAGENE THEORY SUGGESTED KAPPA BODIES WERE GENES WITHIN THE CYTOPLASM

❖***Plasmagenes defined as self-replicating structure capable of producing traits that exist in the cytoplasm and are independent of chromosomal genes.***

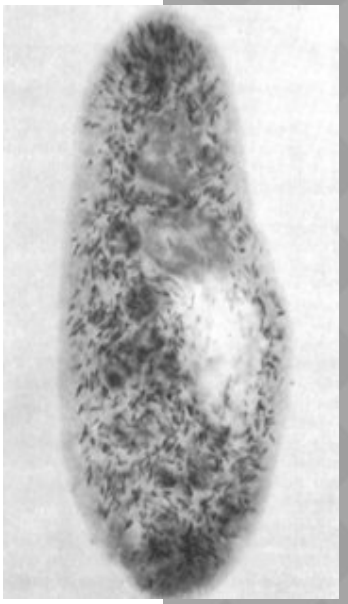
❖**The trait that Kappa bodies produce is the killing factor**

❖***Kappa bodies are inherited through the cytoplasm and not through chromosomes***

❖***Sonneborn wrote in 1976, "It was awful of me to be so attached to a pet idea. That was an ordeal between my mind and my heart and it took a while for the mind to win and the heart to accept. Impersonal scientific objectivity is a goal to be sought by hard self-discipline; we are not born with it."***

ALTENBURG'S EVIDENCE THAT KAPPA BODIES ARE SYMBIONTS IS STRONGLY SUPPORTED BY EVIDENCE

- ***Preer (1948) showed Kappa is large enough to see under a light microscope***
- ***38° C kills Kappa but not Paramecium***
- ***Division of Kappa and Paramecium is independent of each other***
- **There is an upper limit of the number of Kappa in *Paramecium***
- ***More likely a symbiont than a parasite***



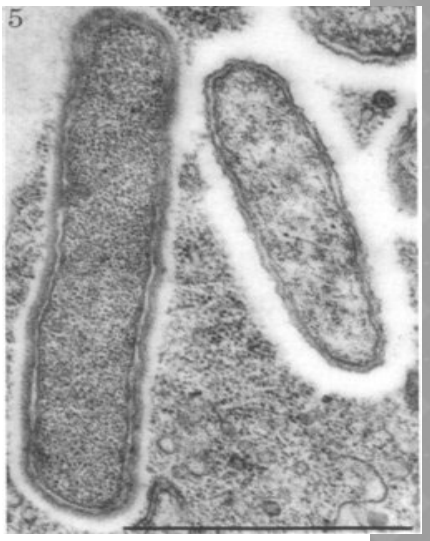
Paramecium with symbiont

PREER (1974) REVIEWED THE OVERWHELMING EVIDENCE THAT KAPPA BODIES ARE SYMBIONTS

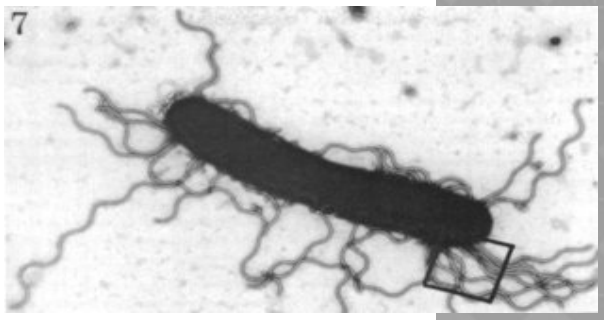
- ***Kappa contains DNA, RNA, protein, and lipids in proportions expected in bacteria***

- ***Kappa contains electron transport system with cytochromes similar to bacteria and not eukaryotes***

- ***Electron microscopy clearly showed that Kappa is prokaryotic***



Electron micrograph of symbionts



Electron micrograph of flagellated Kappa

CURRENT INFORMATION HAS SHOWN WHY KAPPA INDUCES KILLING AND THE DIFFERENT TYPES OF BACTERIA SYMBIOSIS

- *Kappa bodies kill other Paramecium by releasing toxins into the environment*
- *The presence of the symbiont makes the host resistant to the toxin*
- *Kappa bodies are transmitted by the cytoplasm during asexual division*
- *Many other types of symbionts found*
- *Kappa is the most common*

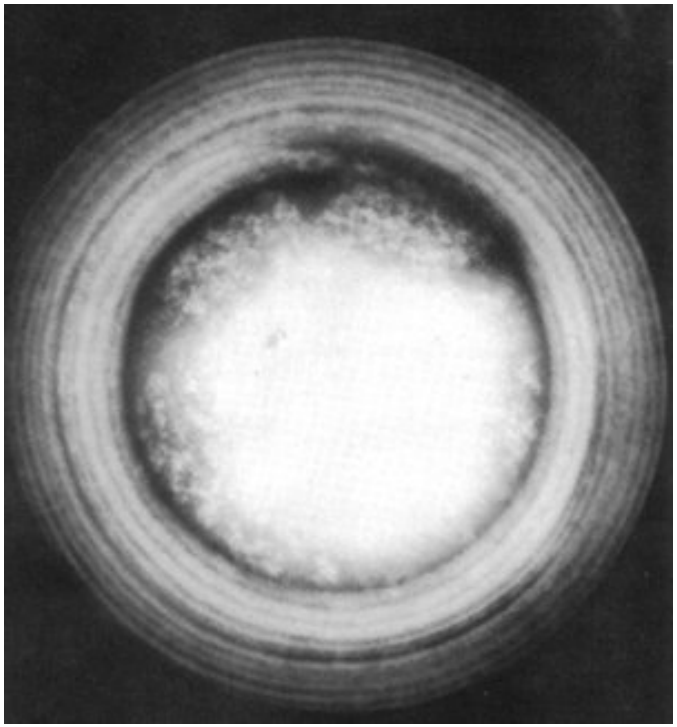
sigma *gamma* *lambda* *alpha* *pi* *delta* *omega* *mu*

THE DISCOVERY OF BACTERIAL SYMBIONTS WITHIN PARAMECIUM ALLOWS FOR THEIR TAXONOMIC CLASSIFICATION

- ***Kappa, mu, gamma, and nu are in genera Caedobacter***
- ***Alpha bodies are in the genera Cytophaga***
- ***Lambda and sigma are in genera Lyticum***
- ***Delta bodies are in genera Tectobacter***

DIFFERENCES HAVE BEEN FOUND BETWEEN KAPPA BODIES IN THE SAME HOST

Some Kappa bodies contain refractile (R) bodies



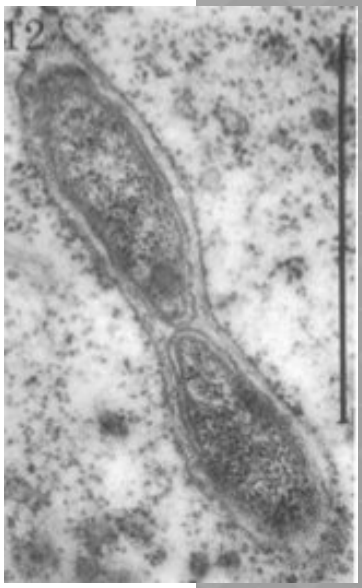
Magnified image of coiled R body (2)

❖*R body is a type of inclusion body*

❖**When genes from one organism are within another organism and are transcribed, a inactive protein may form**

KAPPA BODIES MAY CONTAIN 'R' BODIES AND IT AFFECTS THEIR REPRODUCTIVE CAPABILITY

- ***Non bright Kappa bodies do not contain R bodies but can reproduce***
- ***Bright Kappa bodies do contain R bodies but cannot reproduce***
- ***Non bright produce other non bright, but occasionally a non bright turns into a bright***
- ***Toxicity associated only with Brights***



Dividing symbiont

THERE IS STILL UNSOLVED QUESTIONS REGARDING KAPPA BODY SYMBIOSIS

- ***What benefit does Paramecium get from the symbiosis?***

- ***How does the presence of a Kappa body induce resistance to the toxin?***

- ***Resistance can be overcome with large toxin dose***

- ***The presence of Kappa with or without R bodies induces resistance to the toxin***