

# Alternative Ideas

# Alternative Ideas

A different initial genetic substance + genetic takeover

e.g. clay life

Panspermia

Various versions

Creationism

# Clay Life

A.G. Cairns - Smith

Silicate Life?

Early Genetic Material

O = Si = O but O can make another bond instead



Layers - clay

Also occasional impurity (Al, Mg, ...)

Can grow by adding dissolved material

Tends to copy pattern of impurities in adjacent layers.

Could this be a kind of reproduction?

Defects - different impurity, ... (mutations?)

Sheets can separate - move - and then  
“reproduce”

### Advantages

Clay clearly present

Simpler genetic structure

Crystal growth occurs naturally

### Problem

How to get to  
life as we know it

Clay Life  $\xrightarrow{?}$  Life

Clay life begins to synthesize, use “organic”  
[carbon] molecules

Clays do have some catalytic activity

Genetic takeover

organics  $\longrightarrow$  protein/RNA mechanisms

Clay discarded

# Tests

1. Surviving clay life - unlikely
2. New clay life - maybe in some places
3. Demonstrate in lab

# Focus on Energy

G. Wächtershäuser

Inorganic - organic connection

$\text{FeS}_2$  (Iron pyrite)

Attracts negatively charged molecules

Surface catalysis provides energy via formation from

$\text{FeS} + \text{H}_2\text{S}$

Scene is hot sulfur vents on sea floor

Some recent successes in simulations

Amino acids formed peptide bonds

# Panspermia

- Life arose elsewhere and was delivered here
  - Original idea was bacterial spores
  - Hoyle and Wickramasinghe
    - Life originates on dust grains, comets, ...
  - May be revived (meteorites from Mars)
- Directed panspermia
  - Crick and Orgel (tongue in cheek)
  - Earth seeded by intelligent ET

# Creationism

- Traditional biblical literalism
- Intelligent design
  - Seeks evidence of design in complexity
  - Current version of creationist movement
  - Hoyle and Wickramasinghe later ideas
    - Life designed by silicon chip
    - Where did the chip come from?
- None of these are scientific theories
  - The key is whether they can be tested

# From "Scientific Creationism" by Henry Morris

## Uniformitarianism

Matter existed  
in the beginning  
Sun and stars  
before the earth  
Land before the oceans  
Sun, earth's first light  
Contiguous atmosphere  
and hydrosphere  
Marine organisms,  
first forms of life  
Fishes before fruit trees  
Insects before birds  
  
Sun before land plants  
  
Reptiles before birds  
  
Woman before man  
(by genetics)  
Rain before man  
"Creative" processes still continuing  
Struggle and death necessary  
antecedents of man

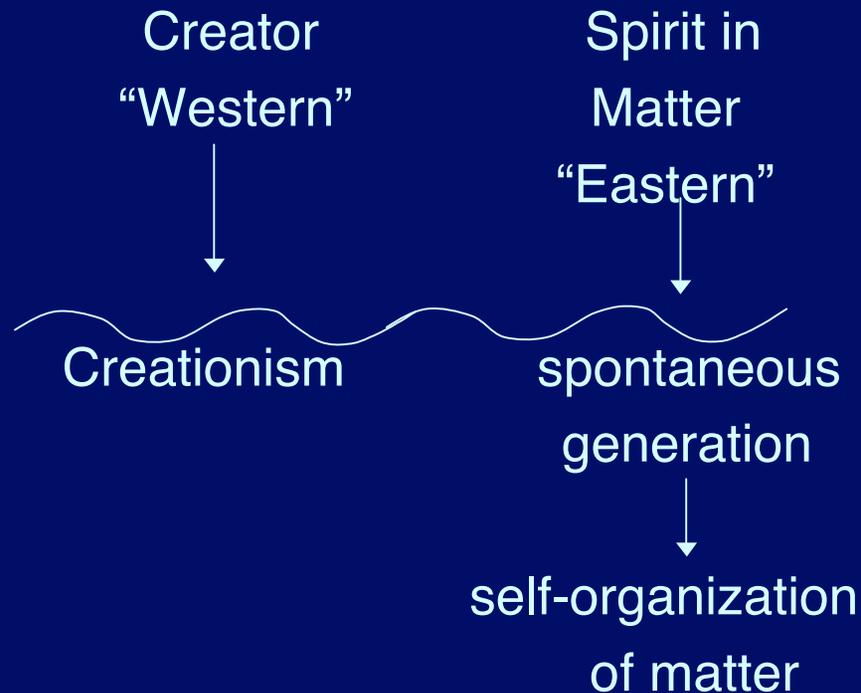
## Bible

Matter created by God  
in the beginning  
Earth before the sun  
and stars  
Oceans before the land  
Light before the sun  
Atmosphere between  
two hydrospheres  
Land plants, first life  
forms created  
Fruit trees before fishes  
Birds before insects  
  
Land vegetation before the sun  
Birds before reptiles  
  
Man before woman  
(by creation)  
Man before rain  
Creation completed  
Man, the cause of struggle and death

## Myth (Mythos)

Revealed truth unquestioned

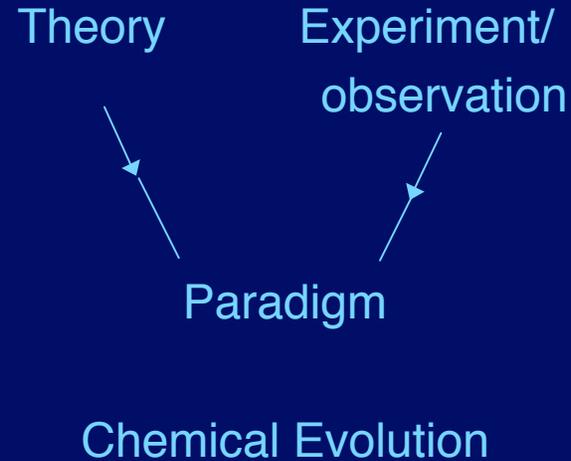
Two strands in  
Creation Myths:



## Science (Logos)

Provisional truth  
Skepticism essential  
(falsifiability)  
Method important

Interplay:



related?

# Artificial Life?

- Polio virus constructed from “scratch” in 2002
- Have they created life?
- Viruses are parasites, but “protolife”?
- Could we create free-living organism?
- Far too complex for current abilities

# Exotic Life Forms?

## Antidote to Earth Chauvinism

1. Different organic molecules (e.g., PNA)  
possibility of life based on other polymers
2. Not based on Carbon  
Silicon (Si) instead of Carbon?  
(also 4 bonds)  
& more (135 ×) more abundant on Earth

## Negatives for replacing carbon with silicon:

a. C - C bond                      2 × stronger than Si - Si

b. Si - O    stronger than Si - Si

→ silicates, not .. Si - Si - Si ...

c. C forms multiple bonds    (e.g. C ≡ N)

Si rarely does

d. C + O    →    CO or CO<sub>2</sub>    (gas - further reacts)

Si + O                      SiO<sub>2</sub>                      - silicate rocks

⇒ Si unlikely to replace C

SiO<sub>2</sub>    (clay life)?

### 3. Other Solvents

Earth:        Liquid water        273-373 K

| Alternatives:  |                        | $T_{\text{freeze}}$ | $T_{\text{boil}}$ |
|----------------|------------------------|---------------------|-------------------|
| Ammonia        | $\text{NH}_3$          | 195                 | 240               |
| Methyl Alcohol | $\text{CH}_3\text{OH}$ | 179                 | 338               |
| Methane        | $\text{CH}_4$          | 91                  | 109               |
| Ethane         | $\text{C}_2\text{H}_6$ | 90                  | 184               |

Water is better solvent

Also better for temperature regulation

But others could play a role in colder zones  
extend CHZ?

## 4. Non-chemical life?

Disembodied intelligence

Black cloud life?

Other forces

Strong nuclear force?

$$\tau \sim 10^{-15} \text{ s}$$

Gravity?

## Estimates for $f_\ell$

- Possible range is very large
  - Perhaps  $10^{-6}$  (one in a million) to 1 (all)
- Arguments for large value
  - Life part of overall evolution in complexity
  - Arises naturally from interplay of forces

## Estimates for $f_\ell$

- Arguments for small value
  - May need more than liquid water
    - Large tides, so large moon
    - Dry land (for polymerization)
  - Life may be a fluke
    - A rare statistical event

Can we estimate  $f_\ell$  from early origin of life?

Very ancient microfossils (now disputed)

⇒ Life arose as early as  $3.8 \times 10^9$  yr ago  
[soon after end of heavy bombardment]

Lineweaver & Davis argued:

Early origin ⇒  $f_\ell > 0.33$

For suitable planets older than  $1 \times 10^9$  yrs.

Statistics from one example!

Others have disputed this conclusion

# What is your choice and why?

- The most uncertain factor so far ( $f_{\ell}$ )
- Think about various ideas for origin of life
- Put together a plausible story for the origin of life
  - Can use parts of various ideas, but need to be consistent.