Origen de la vida: el que a Darwin hauria agradat saber

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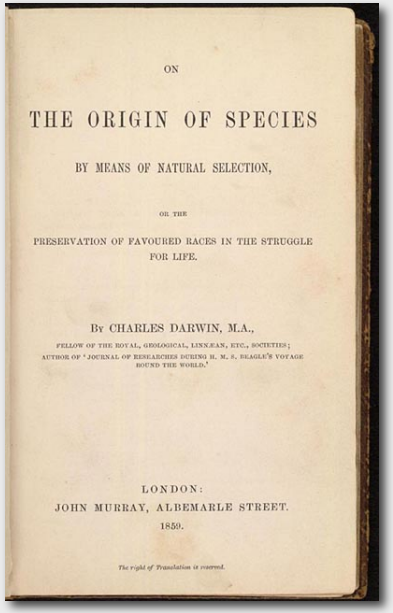
Comunitat d'origen: la gran conjectura de Darwin



ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNÆAN, ETC., SOCIETIES;
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE ROUND THE WORLD.'

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

The right of Translation is reserved.

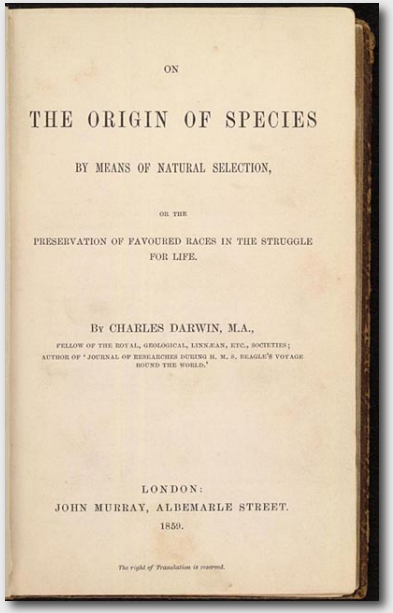
[…] probably all the organic beings which have ever lived on this Earth have descended from some one primordial form.

Darwin 1859:484

L'opinió *pública* de Darwin

There is grandeur in this view of life, with its several powers, having been originally breathed [**by the Creator**] into a few forms or into one [...]

Darwin (1859)
last paragraph [2nd and following eds.]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It will be some time before we see "slime, protoplasm, etc.," generating a new animal. But **I have long regretted that I truckled to public opinion, and used the Pentateuchal term of creation**, by which I really meant "appeared" by some wholly unknown process. It is mere rubbish, thinking at present of the origin of life; one might as well think of the origin of matter.

Darwin's letter to Hooker (1863)

La crítica immediata de Haeckel

The chief defect of the Darwinian theory is that it throws no light on the origin of the primitive organism –probably a simple cell –from which all the others have descended. When Darwin assumes a special creative act for this first species, he is not consistent, and, I think, not quite sincere...

Ernst Haeckel
(1834-1919)

Ernst Haeckel *Die Radiolarien* 1862

L'opinió *privada* de Darwin

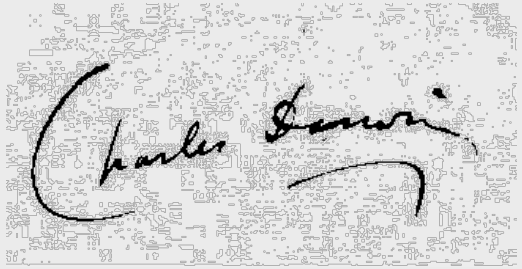
But if (and oh! what a big if!) we could conceive in some warm little pond, with all sorts of ammonia and phosphoric salts, - light, heat, electricity, etc., present, that a protein compound was chemically formed, ready to undergo still more complex changes [...]

Darwin's letter to Hooker (1871)

Darwin –Tant de bo la generació espontània fos certa !

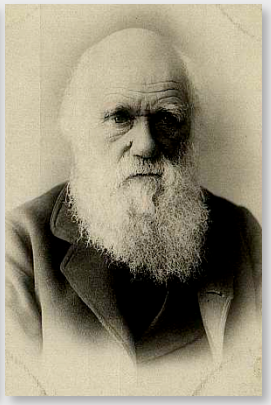
Down, September 25, 1873.

My Dear Häckel,
I thank you for the present of your book,* and I am heartily glad to see its great success. You will do a wonderful amount of good in spreading the doctrine of Evolution, supporting it as you do by so many original observations. [...] I will at the same time send a paper which has interested me; it need not be returned. It contains a singular statement bearing on so-called Spontaneous Generation. I much wish that this latter question could be settled, but I see no prospect of it. **If it could be proved true this would be most important to us** [...].
Wishing you every success in your admirable labours,
I remain, my dear Häckel, yours very sincerely,



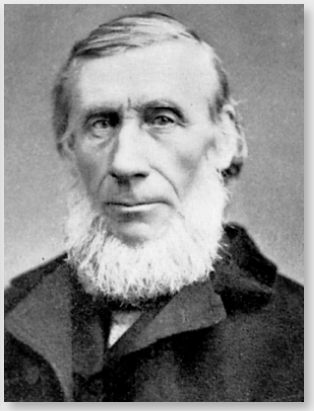
*'Schöpfungs-Geschichte,' 4th ed. The translation ('The History of Creation') was not published until 1876

Les eixides del dilema

L'emergència de la vida per causes naturals

vs.

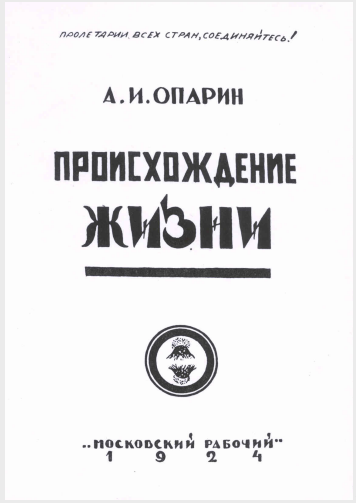



La impossibilitat de la generació espontània

Panspèrmia **Haeckel i el monisme** **Neovitalisme**

L'origen de la vida com un problema químic i evolutiu

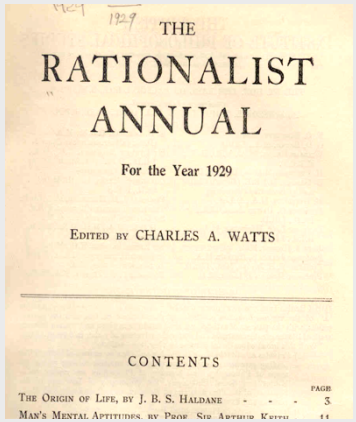
1924



síntesis abiòtiques → fermentació primordial

Aleksandr I. Oparin
(1894-1980)

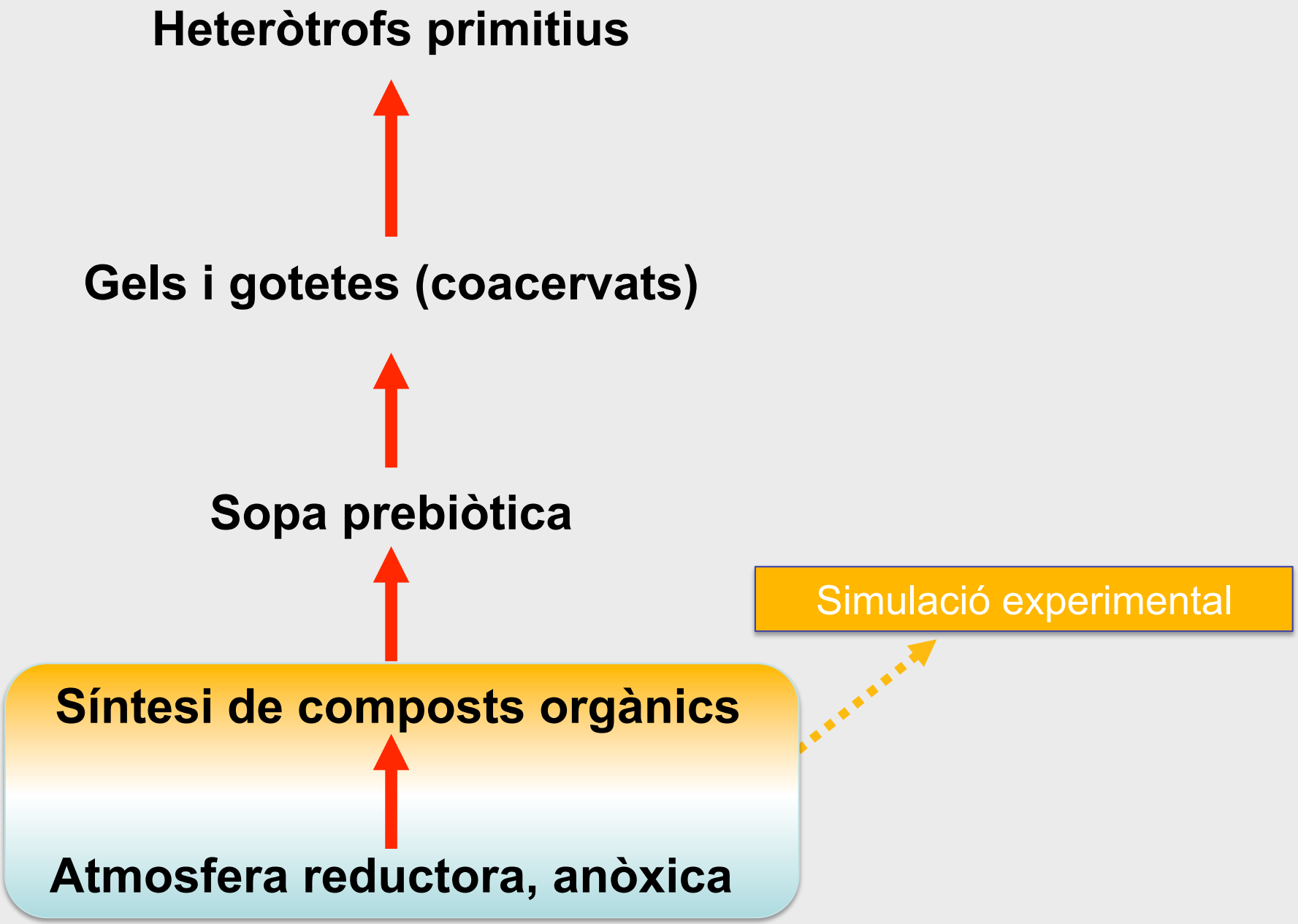
1929



sopa primitiva → virus → heteròtrofs

J. B. S. Haldane
(1892-1964)

Orígens heterotròfics de la vida segons Oparin



Recerca sobre origen de la vida: el context tecnocientífic

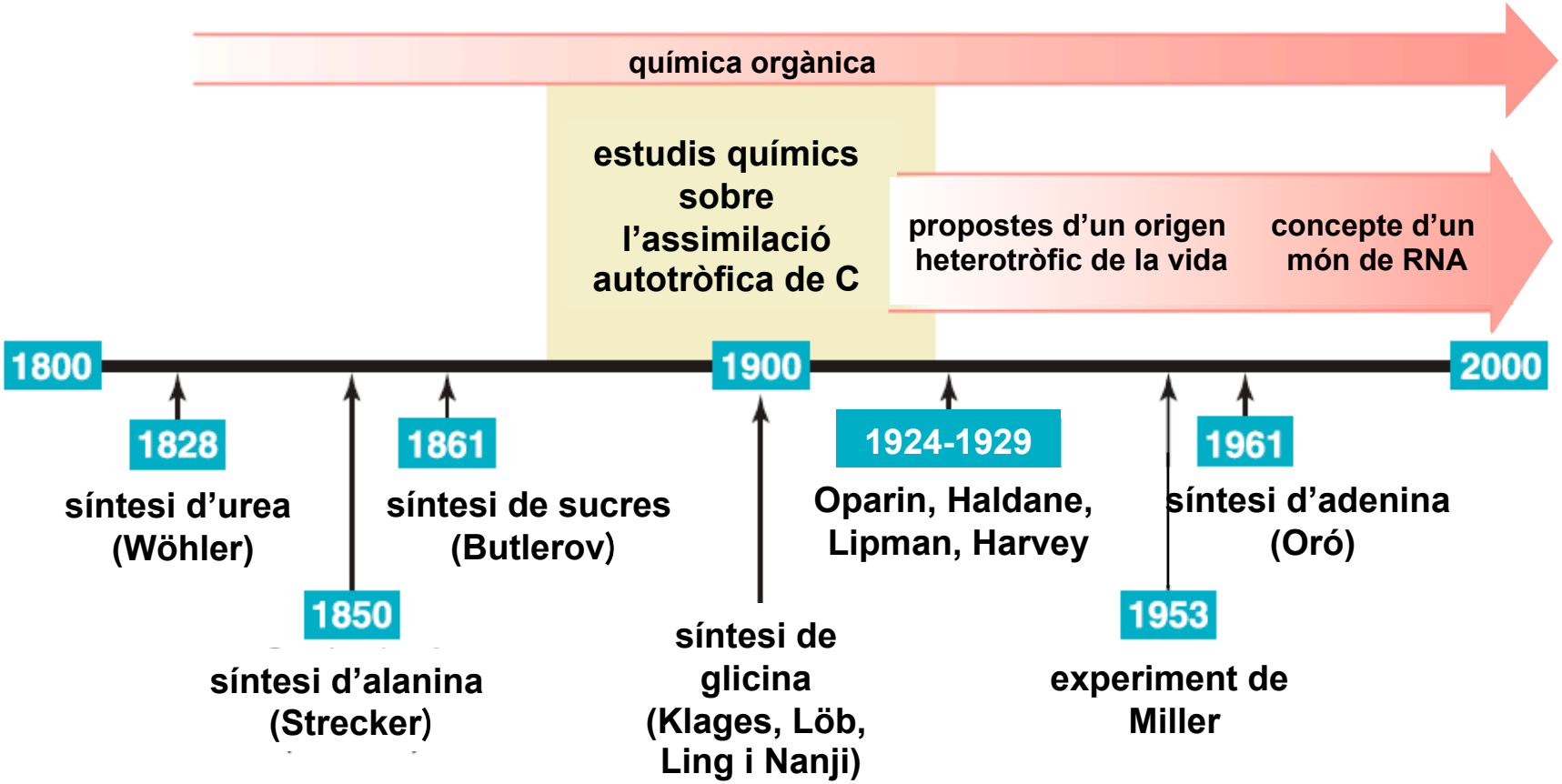
1. Des de finals dels 1940s, la biologia evolutiva esdevingué un camp d'investigació consolidat i als 1950s s'establí la química prebiòtica

2. Establiment dels programes espacials (des de 1957) i desenvolupament d'una química analítica extraterrestre

3. Des dels 1960s es desenvolupa una biologia evolutiva molecular, incloent-hi la visió filogenètica universal de la vida

4. Des dels 1960s-70s es descobreixen els microorganismes extremòfils i es desenvolupa la micropaleontologia

5. El 1981 es decobreix l'RNA catalític



Fites de la síntesi orgànica i teories de l'origen de la vida

De: Bada & Lazcano (2003) *Science* **300**: 745

De la geoquímica a la bioquímica

Quan?

1 Ga = 10^9 anys

4,4-3,8 Ga

condicions favorables

hidrosfera estable

3,8-3,0 Ga abans del present

traces biològiques més antigues

signatures químiques
fòssils cel·lulars

De la geoquímica a la bioquímica

Quan?

4,4-3,8 Ga — **condicions favorables**

3,8-3,0 Ga abans del present — **traces biològiques més antigues**

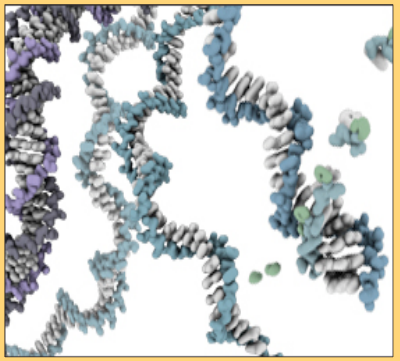
Com?

química prebiòtica → **?** → **cenancestre universal**

lleis fisicoquímiques

selecció natural

La *selecció natural* és possible només en un sistema dotat de replicabilitat i variabilitat, e.g. RNA té la primera propietat; la segona es deriva automàticament de la primera.



De la geoquímica a la bioquímica

Quan?

4,4-3,8 Ga — **condicions favorables**

3,8-3,0 Ga abans del present — **traces biològiques més antigues**

Com?

química prebiòtica → **?** → **cenancestre universal**

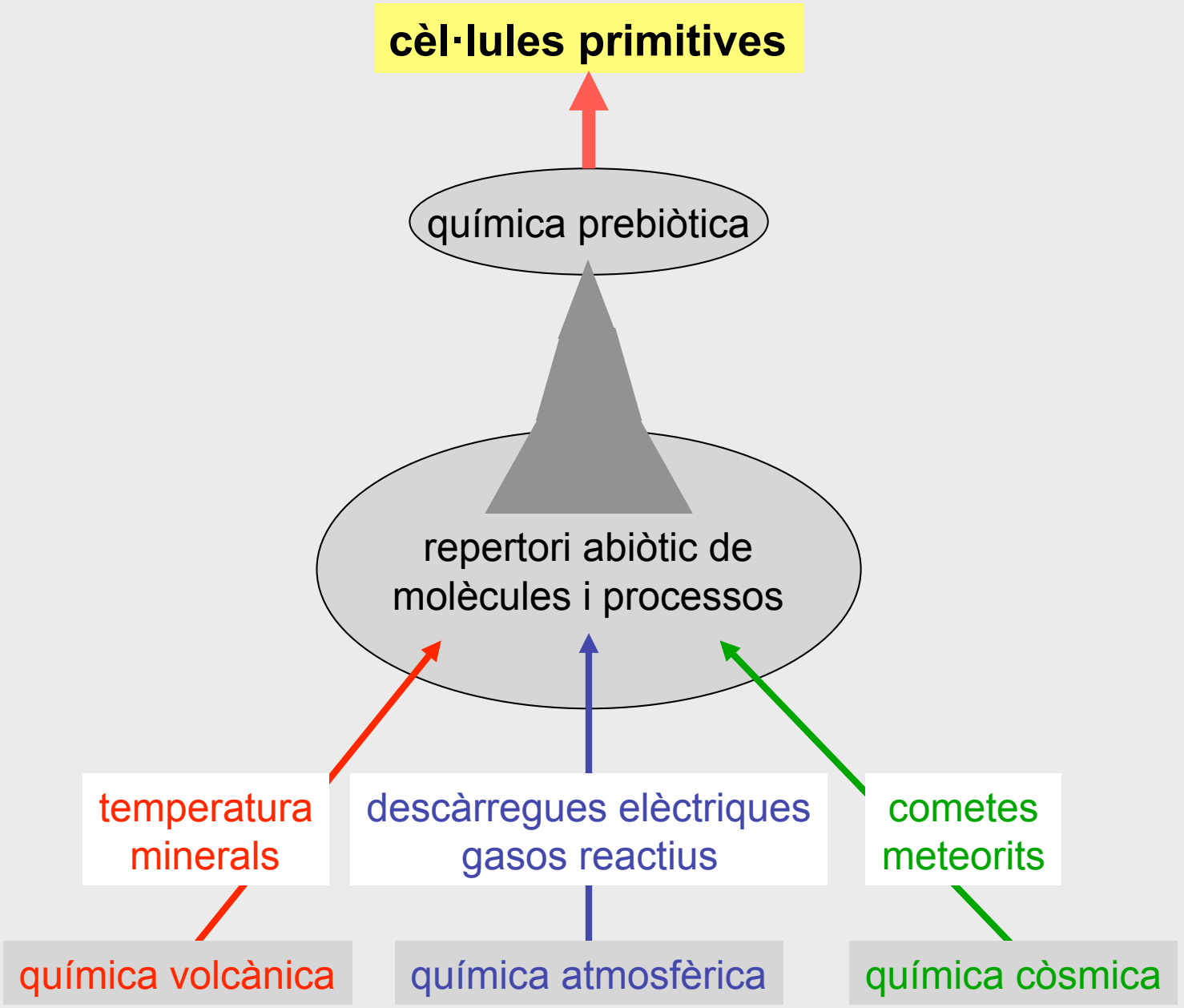
lleis fisicoquímiquesl

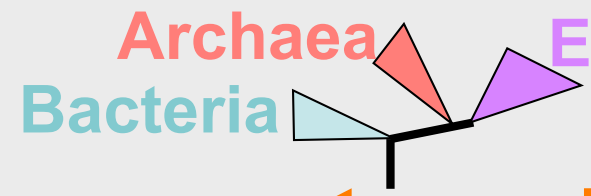
selecció natural

On?

Galunggung, Java (16-10-82)

De la geoquímica a la bioquímica





cenancestre universal

?

química còsmica
química volcànica
química atmosfèrica

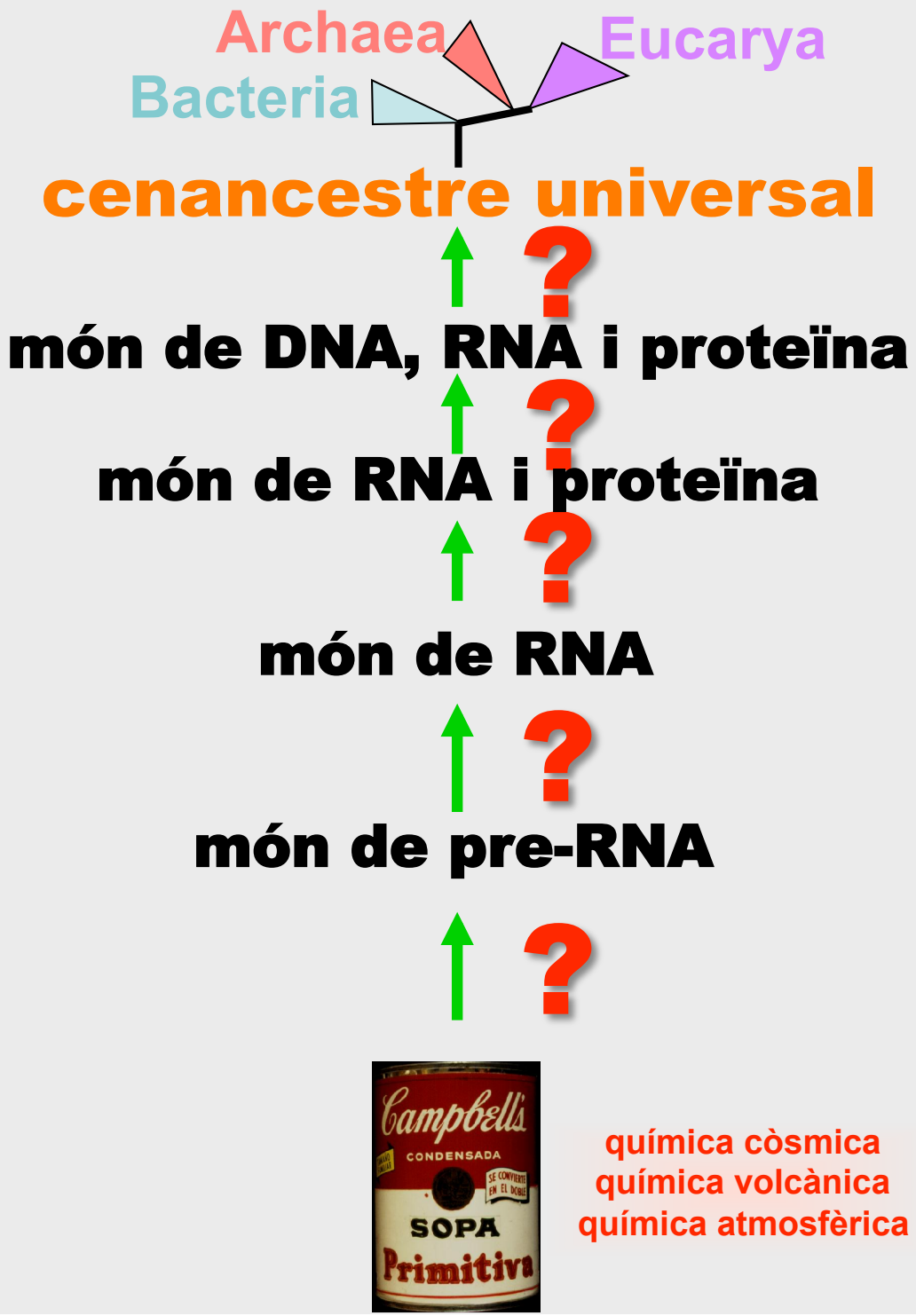
cenancestre universal

?

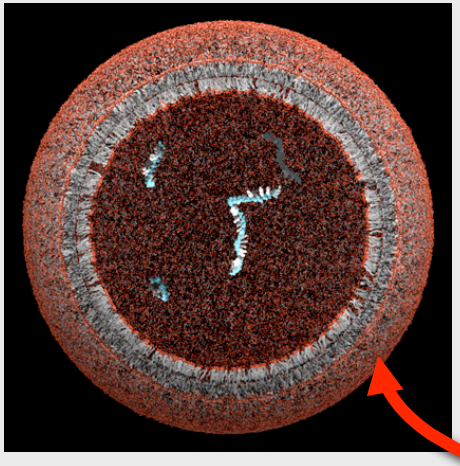
món de RNA

?

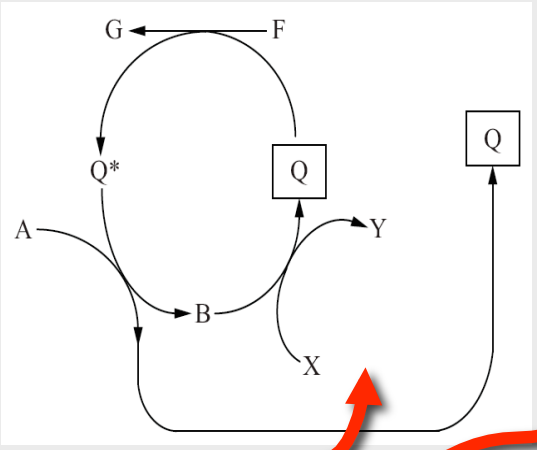
química còsmica
química volcànica
química atmosfèrica


Archaea
Eucarya
Bacteria
cenancestre universal
món de DNA, RNA i proteïna
món de RNA i proteïna
món de RNA
món de pre-RNA
Campbell's
CONDENSADA
SOPA
Primitiva
química còsmica
química volcànica
química atmosfèrica

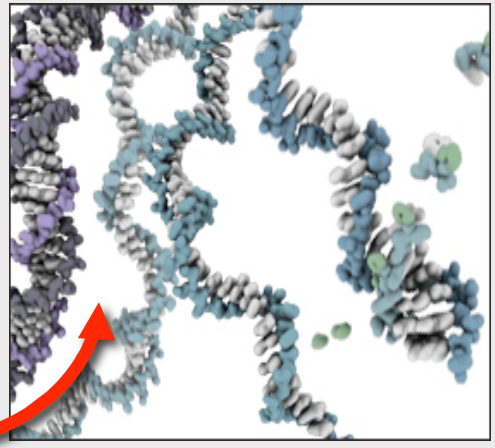
Embolcalls



Metabolismes

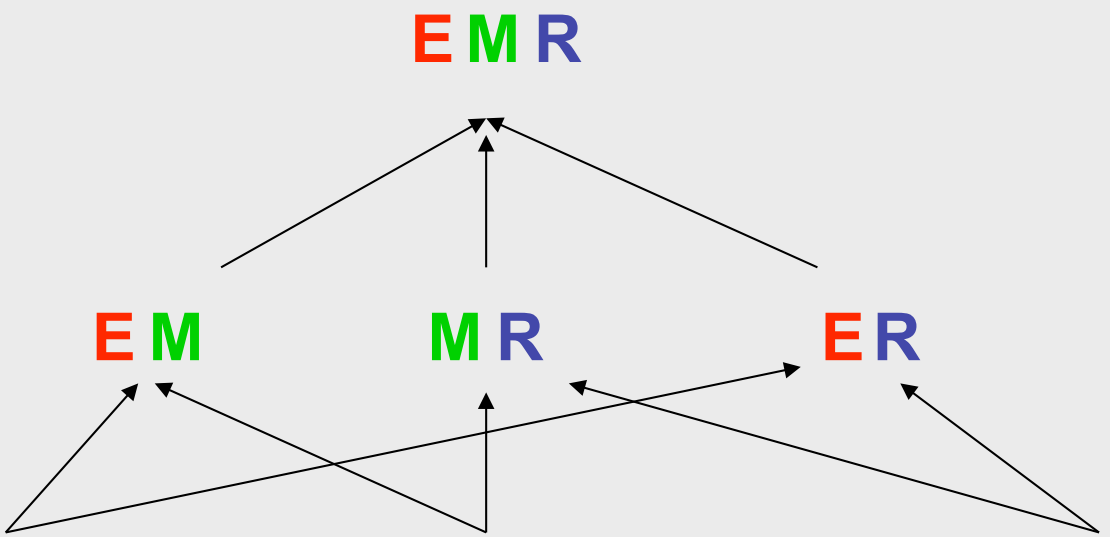


Replicants

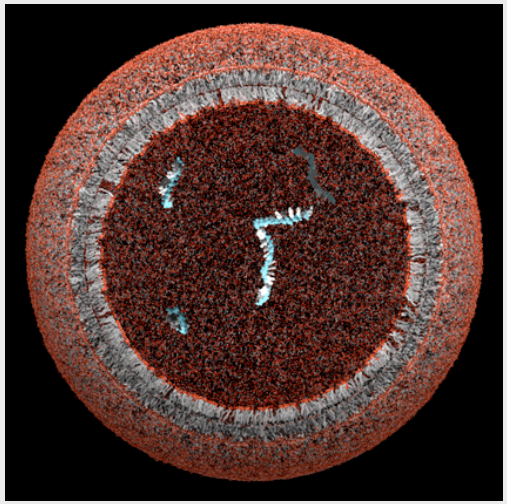


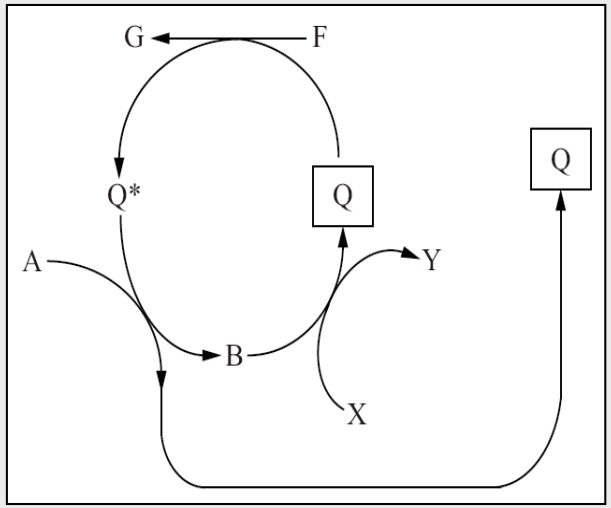
química còsmica
química volcànica
química atmosfèrica

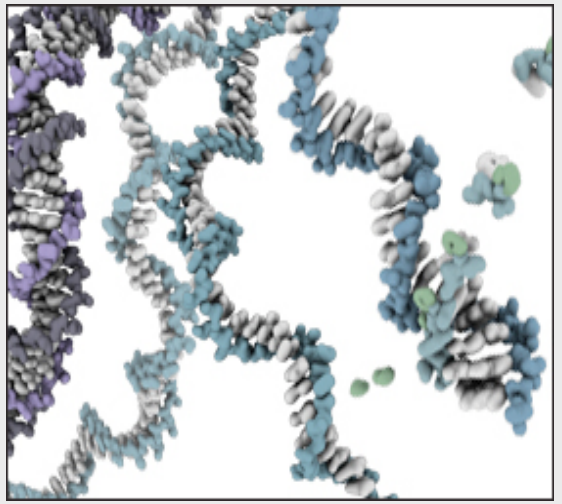
L'articulació de subsistemes supraquímics/infrabiològics



Embolcalls **Metabolismes** **Replicants**





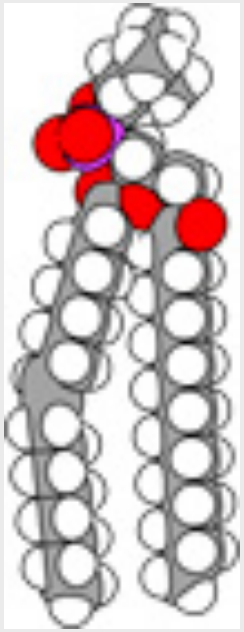


Adaptat de Szathmáry (2007)

Vesícules autoreproductives d'àcids grassos (Jack W. Szostak)

Premi Nobel de fisiologia
o medicina 2009

Prebiòtic
Àcids grassos lineals de cadena curta



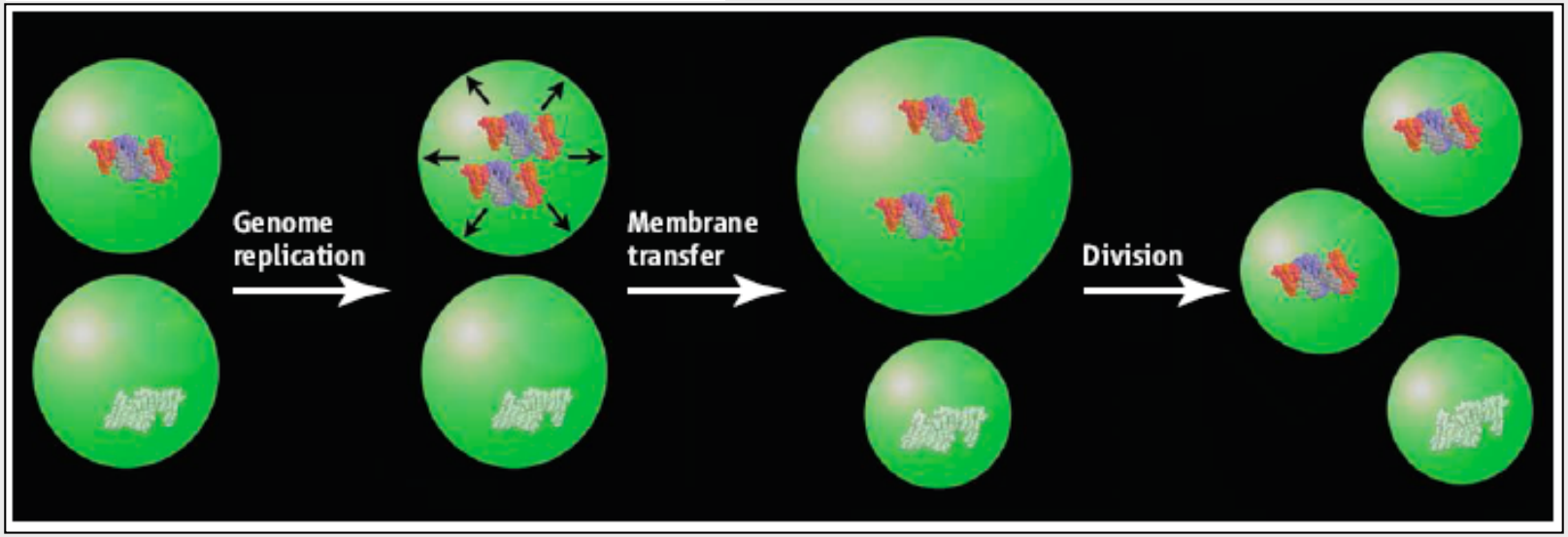
Actual
Fosfolípids

Compromís
Àcid oleic

The Emergence of Competition Between Model Protocells

Irene A. Chen,[1,2] Richard W. Roberts,[3] Jack W. Szostak[1]*

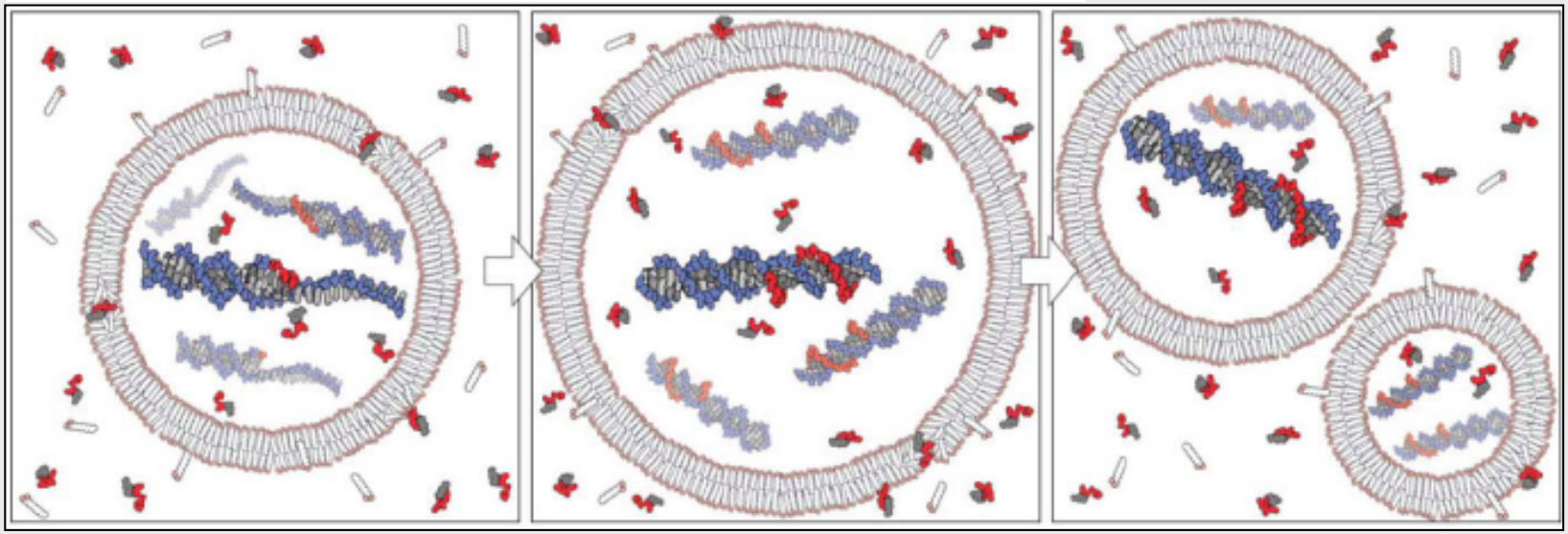
3 SEPTEMBER 2004 VOL 305 SCIENCE



Template-directed synthesis of a genetic polymer in a model protocell

NATURE (2008) 454:122-5

Sheref S. Mansy[1], Jason P. Schrum[1], Mathangi Krishnamurthy[1], Sylvia Tobé[1], Douglas A. Treco[1] & Jack W. Szostak[1]

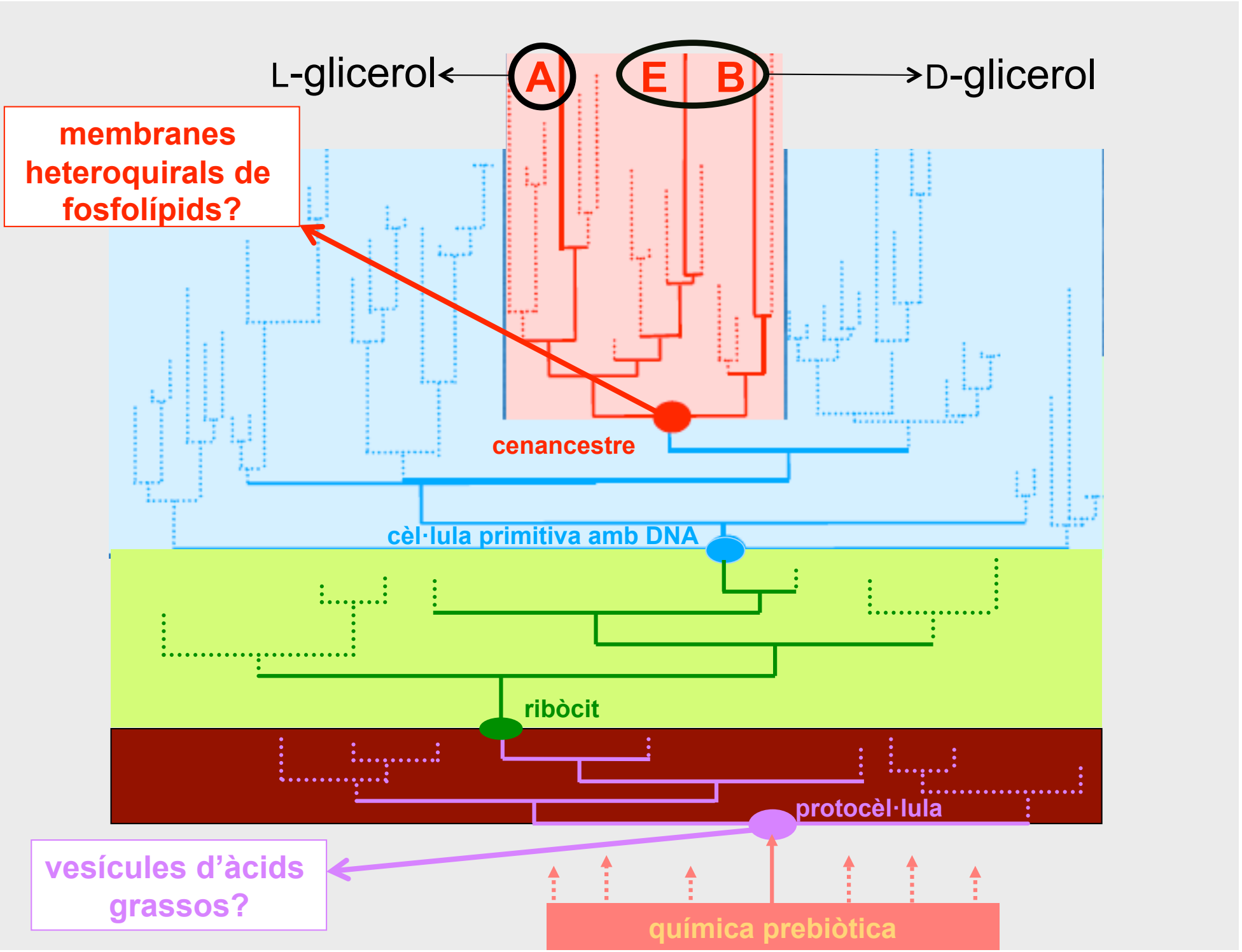


Determinisme i contingència en l'origen de la vida

Stephen J. Gould *Wonderful Life* (1989)

La vida exhibe una estructura que obedece a los principios físicos. No vivimos en medio de un caos de circunstancia histórica no afectada por nada accesible al método científico tal como se concibe tradicionalmente. **Sospecho que el origen de la vida en la Tierra fue prácticamente inevitable**, dada la composición química de los océanos y las atmósferas primitivas y los principios físicos de los sistemas autoorganizativos.
[...] la pregunta de las preguntas queda reducida al establecimiento del **límite entre la predicibilidad** bajo la ley invariable **y las múltiples posibilidades de la contingencia histórica**. [...] casi cualquier acontecimiento interesante de la historia de la vida cae dentro del dominio de la contingencia.

(Trad. J. D. Ros, 1991)


L-glicerol
A
E
B
D-glicerol
membranes heteroquirals de fosfolípids?
cenancestre
cèl·lula primitiva amb DNA
ribòcit
protocèl·lula
vesícules d'àcids grassos?
química prebiòtica

Down, August 28, 1872.

My Dear Wallace,

I have at last finished the gigantic job of reading Dr. Bastian's book [*The Beginnings of Life*] and have been deeply interested by it. You wished to hear my impression, but it is not worth sending.

He seems to me an extremely able man, as, indeed, I thought when I read his first essay. His general argument in favour of Archebiosis is wonderfully strong, though I cannot think much of some few of his arguments. The result is that I am bewildered and astonished by his statements, but am not convinced, **though, on the whole, it seems to me probable that Archebiosis is true**.

[...] **I should like to live to see Archebiosis proved true, for it would be a discovery of transcendent importance**; or, if false, I should like to see it disproved, and the facts otherwise explained; **but I shall not live to see all this**. If ever proved, Dr. Bastian will have taken a prominent part in the work [...].