

Darwin gestern und heute

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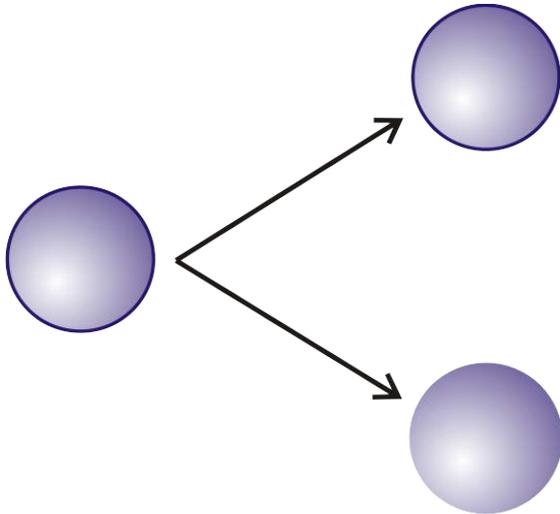
Ignaz Lieben-Symposium 2017

Wien, 09-10.11.2017

Web-Page for further information:

<http://www.tbi.univie.ac.at/~pks>

Vermehrung in einer endlichen Welt



Vermehrung als Grundlage aller evolutionären Prozesse



Thomas Robert Malthus
1766 – 1834

Wachstum tierisch-menschlicher Populationen
führt auf eine geometrische Reihe:

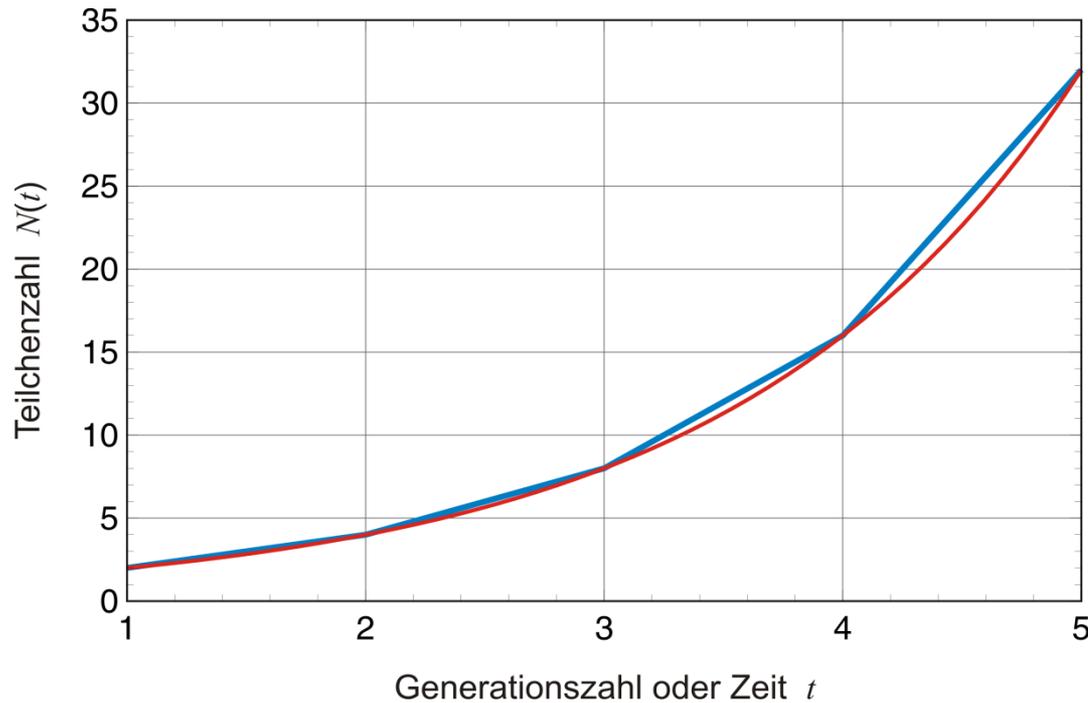
$2 \rightarrow 4 \rightarrow 8 \rightarrow 16 \rightarrow 32 \rightarrow 64 \rightarrow 128 \rightarrow 256 \rightarrow$

Exponentialfunktion

$$N(t) = N_0 \exp(rt)$$



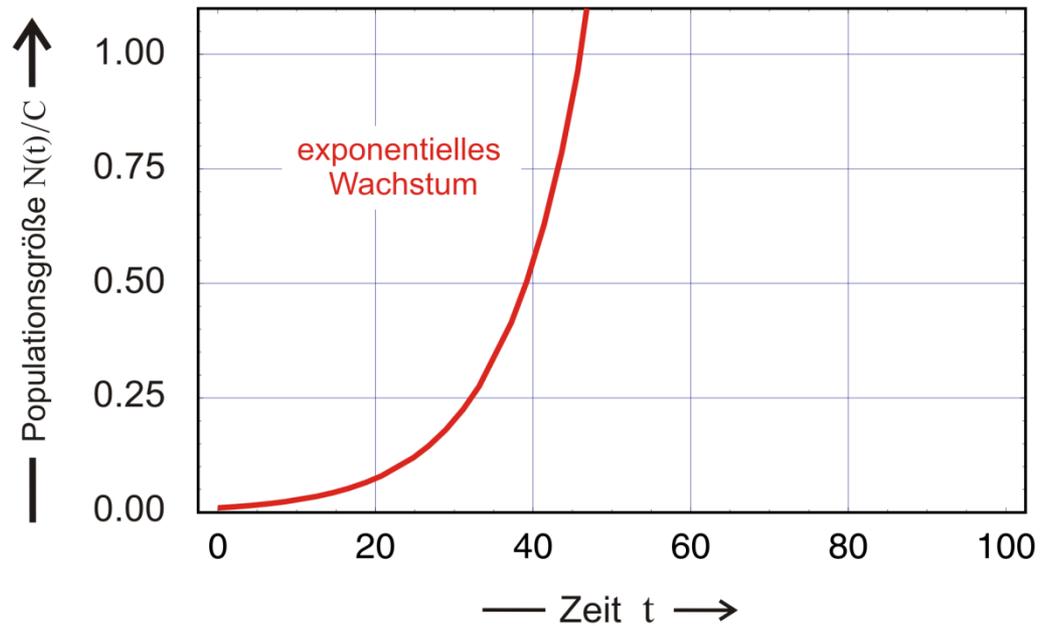
Leonhard Euler
1707 – 1783





Thomas Robert Malthus
1766 – 1834

$$N(t) = N_0 \exp(rt)$$

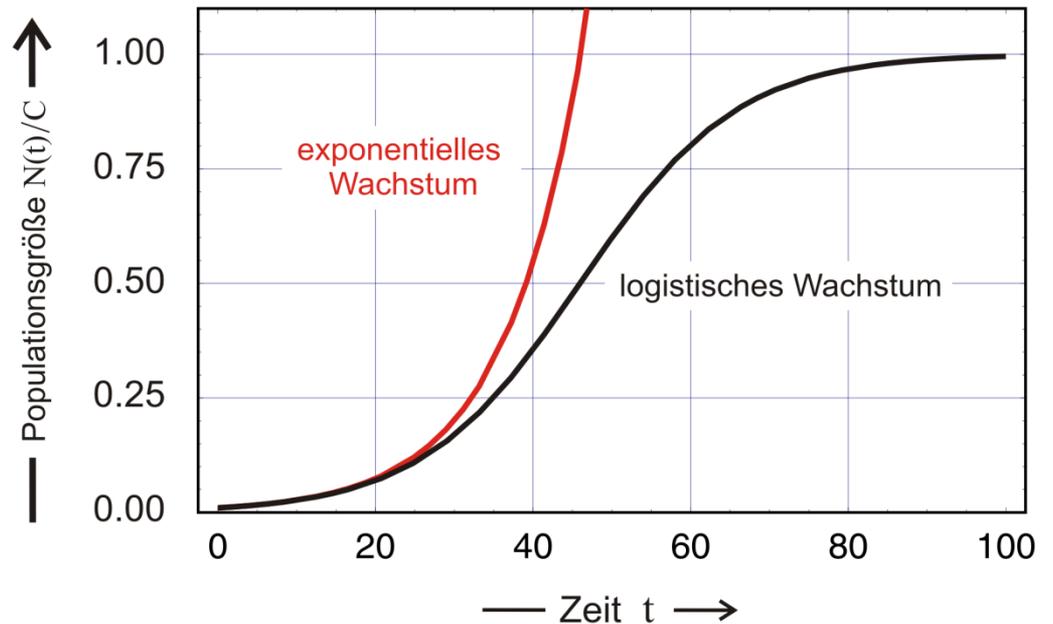


Exponentielles Wachstum, 1798 siebzig Jahre vor Darwins „*Origin of Species*“



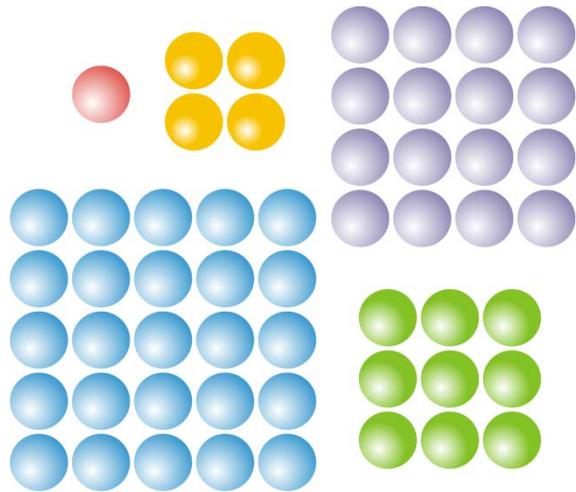
Pierre-François Verhulst,
1804-1849

$$N(t) = \frac{N_0 C}{N_0 + (C - N_0) \exp(-rt)}$$



Logistische Gleichung, 1828 dreißig Jahre vor Darwins „*Origin of Species*“

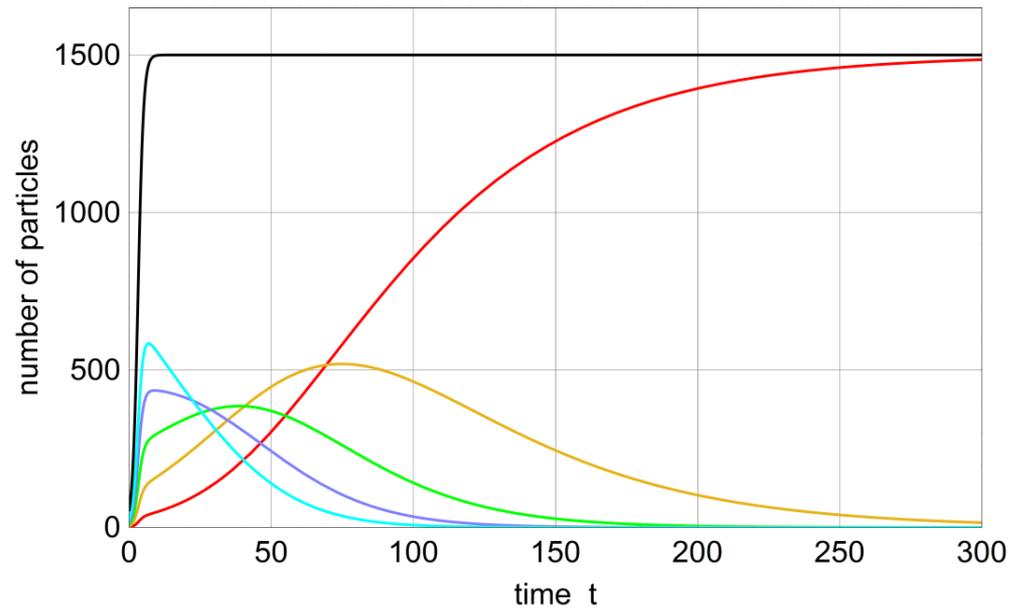
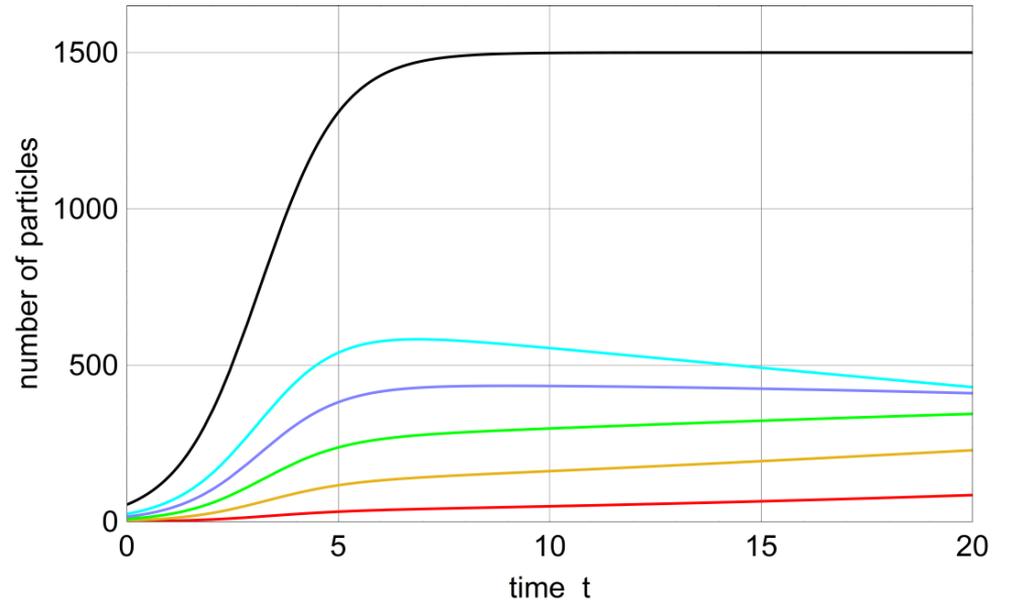
Darwin und Mathematik

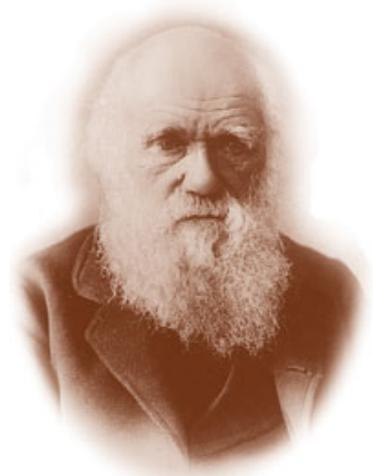


$$N(0) = (1, 4, 9, 16, 25)$$

$$f = (1.10, 1.08, 1.06, 1.04, 1.02)$$

Von Verhulst zu Darwin

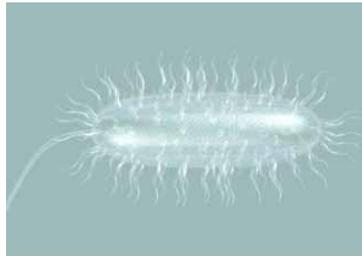




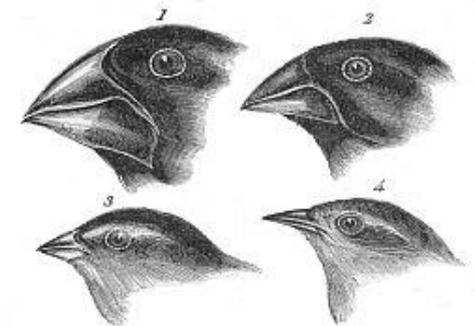
Charles Darwin, 1809 - 1882



Voyage on HMS Beagle, 1831 - 1836

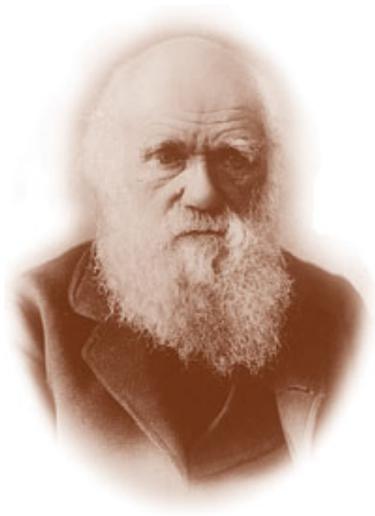


Phänotypen

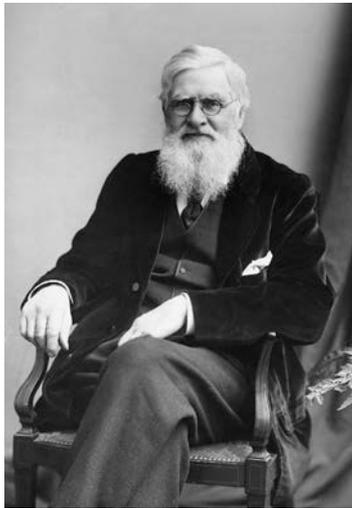


- 1. *Geospiza magnirostris*
- 2. *Geospiza fortis*
- 3. *Geospiza parvula*
- 4. *Certhidea olivacea*

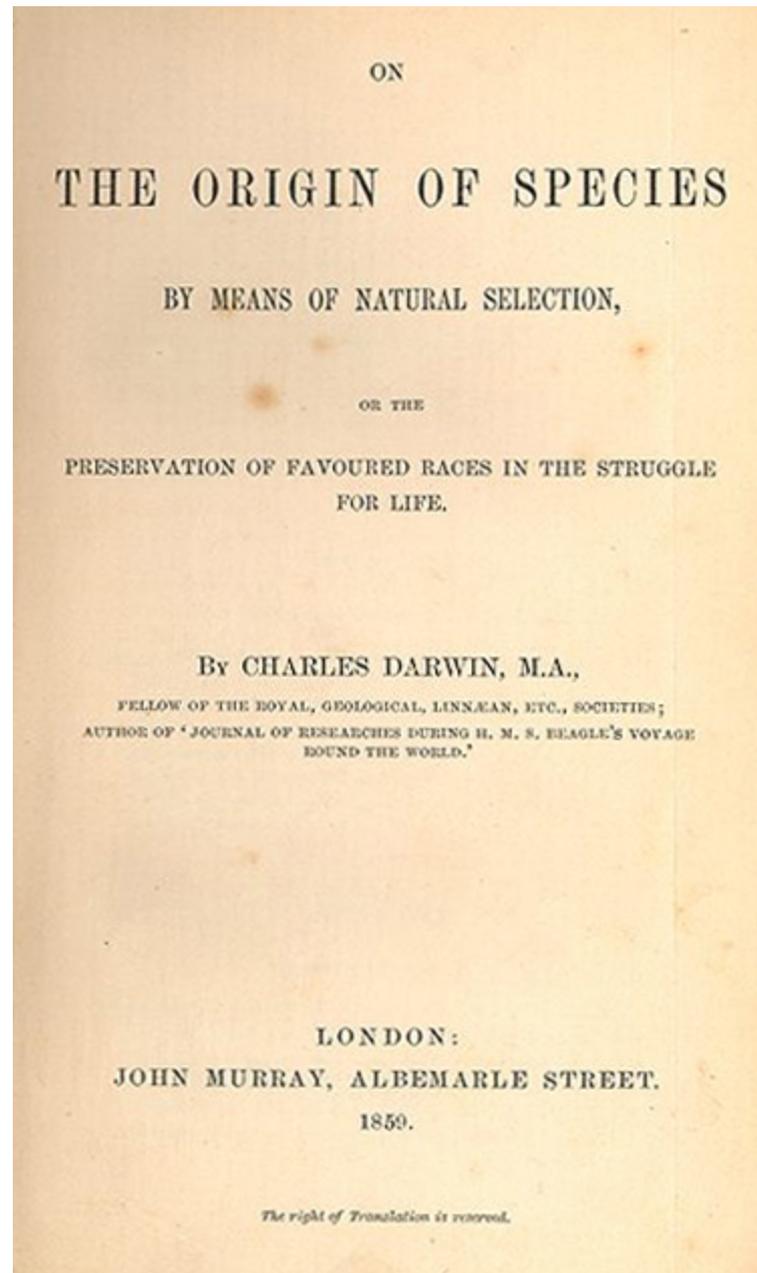
Finches from Galapagos Archipelago



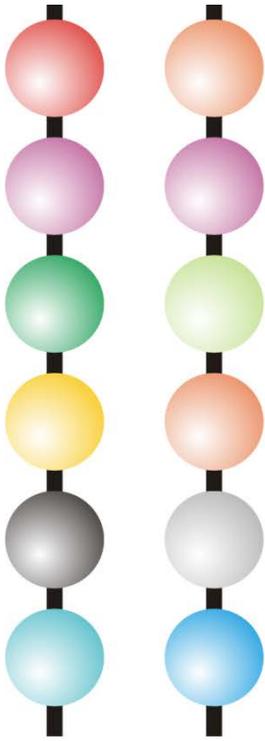
Charles Darwin, 1809 - 1882



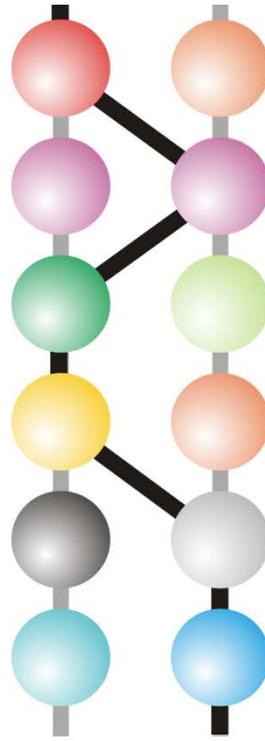
Alfred Russel Wallace
1823 - 1913



Mendel und die synthetische Theorie



diploide Zelle
somatische Zelle

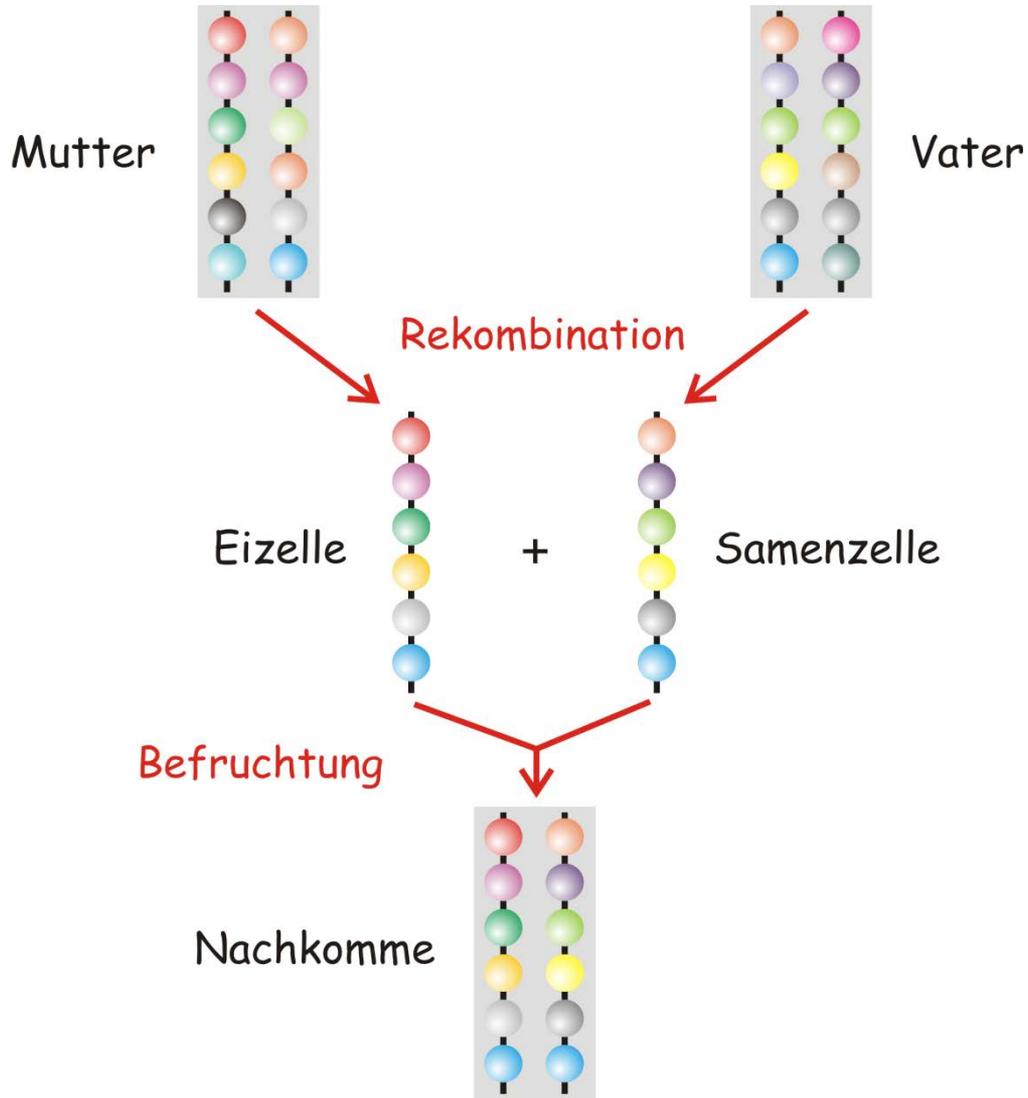


Rekombination
Meiose



haploide Zelle
Ei- oder Samenzelle

Rekombination in Mendels Genetik

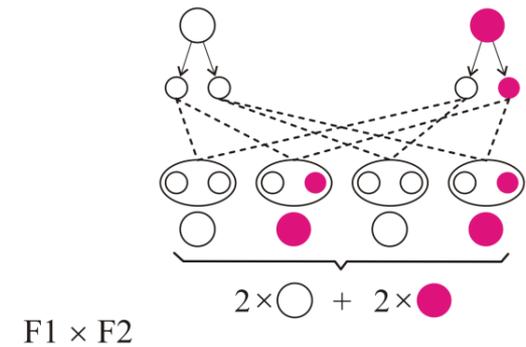
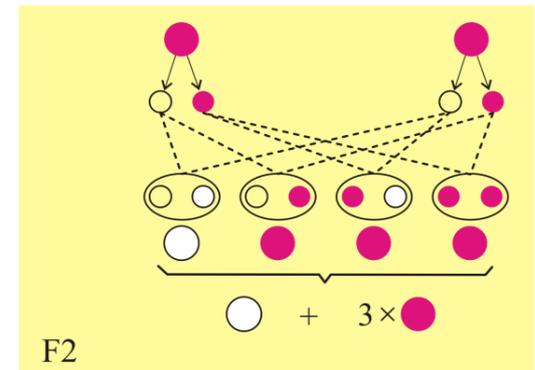
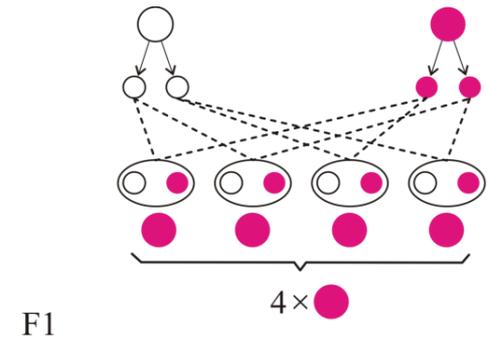
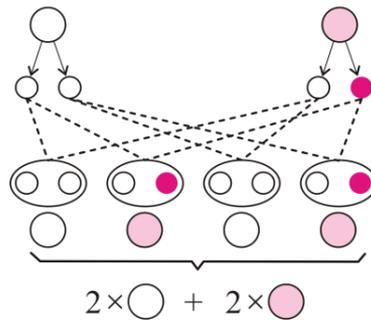
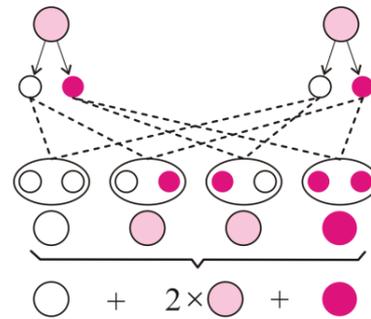
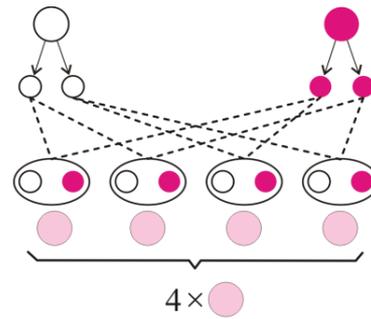


Gregor Mendel, 1822-1884

Rekombination in Mendels Genetik

Mendelsche Genetik

die 1:3 Verteilung
dominant/rezessiver
Merkmale



Intermediäres Allelpaar

Dominant/rezessives Allelpaar



Ronald Fisher (1890-1962)

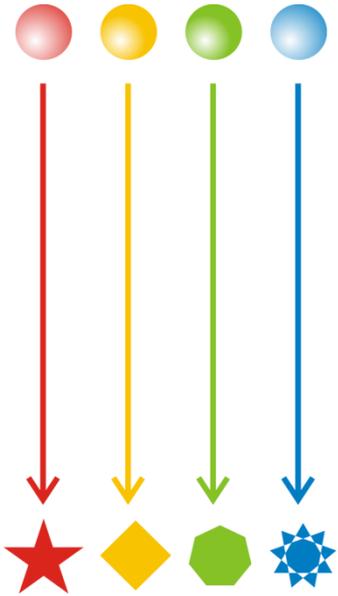


J. B. S. Haldane (1892-1964)



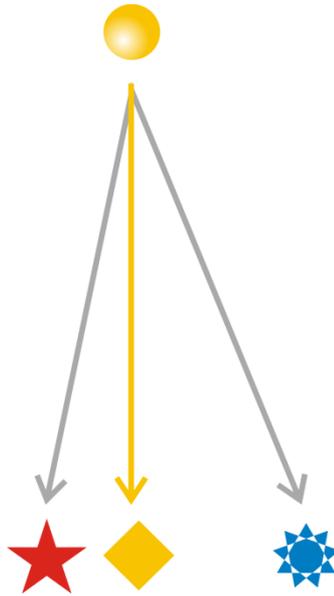
Sewall Wright (1889-1988)

Die drei Begründer der Populationsgenetik

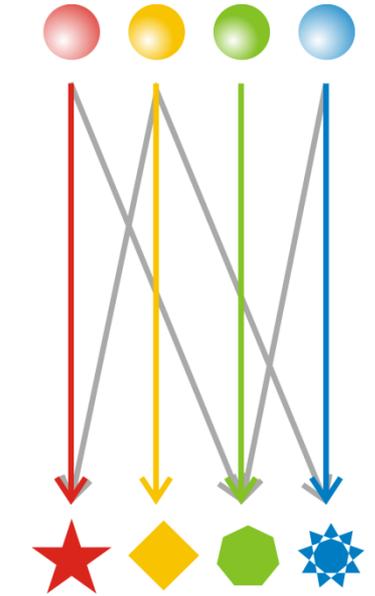
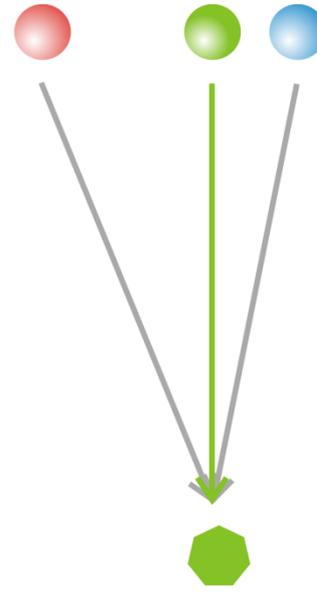


ein Gen - ein Merkmal
Modell

Mendel - Fisher

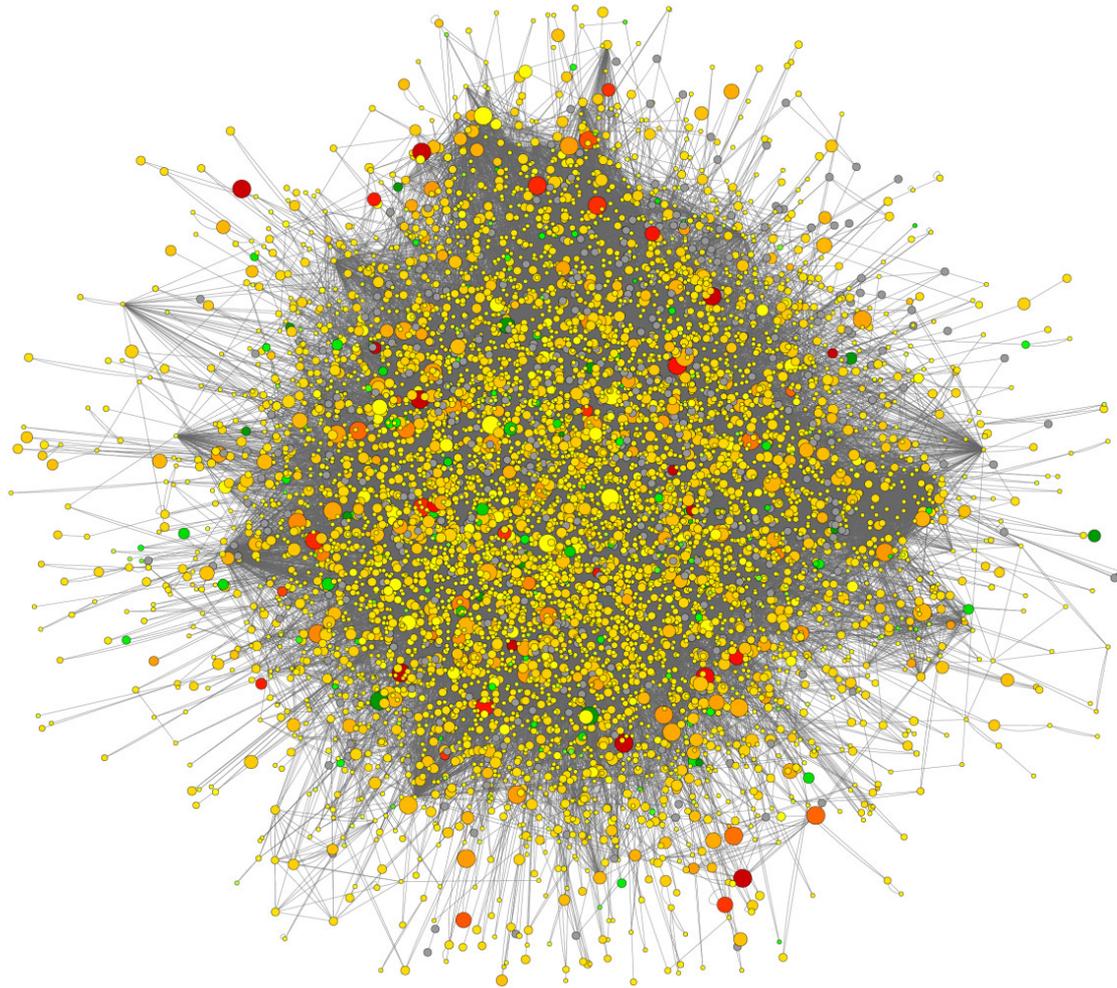


Pleiotropie und Epistasie



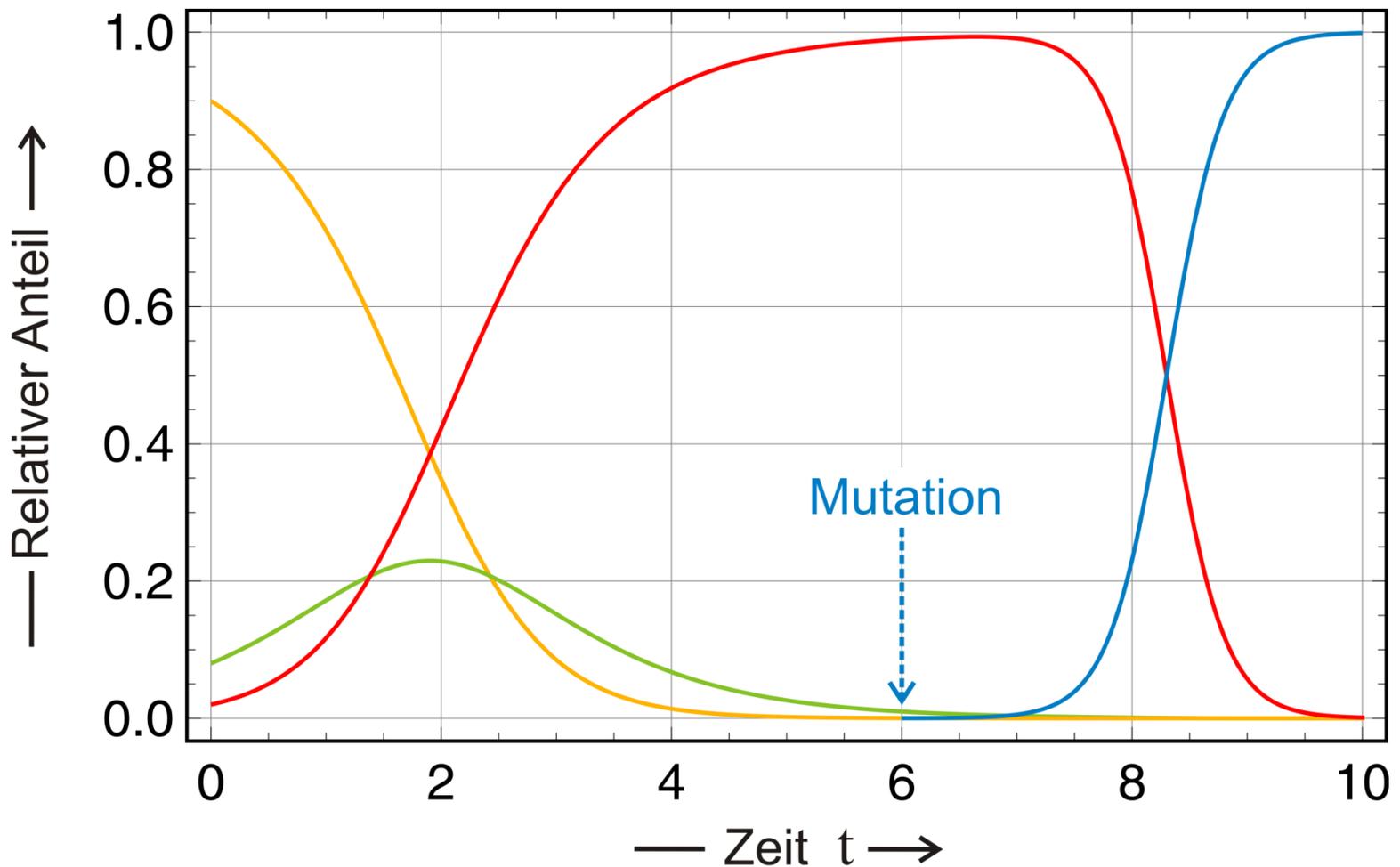
komplexes genetisches
Netzwerk

Wie die Mendelsche Genetik komplex wird



Christopher R. Bauer, Andrew M. Epstein, Sarah J. Sweeney, Daniela C. Zarnescu, and Giovanni Bosco.
BMC Systems Biology 2:e101 (2008).

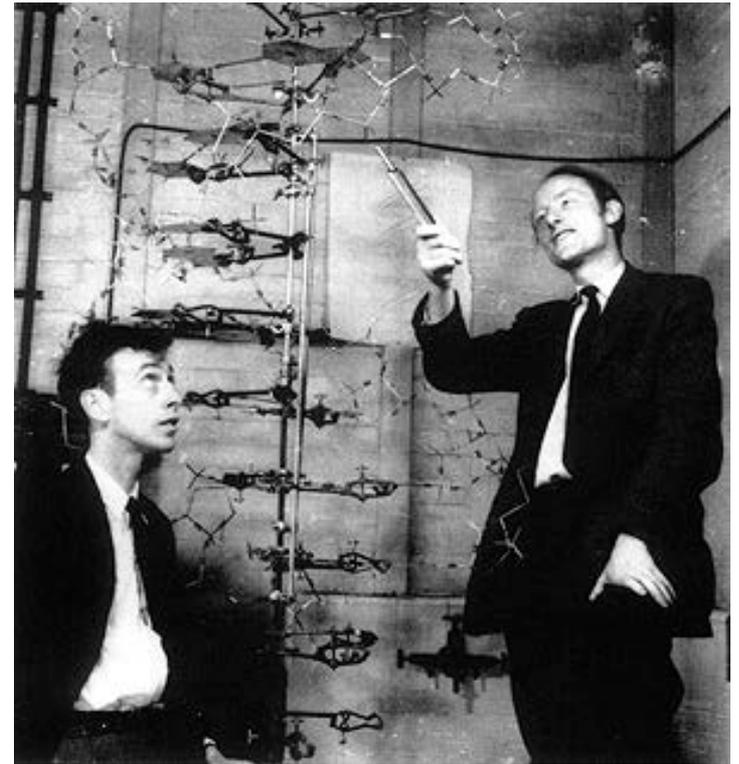
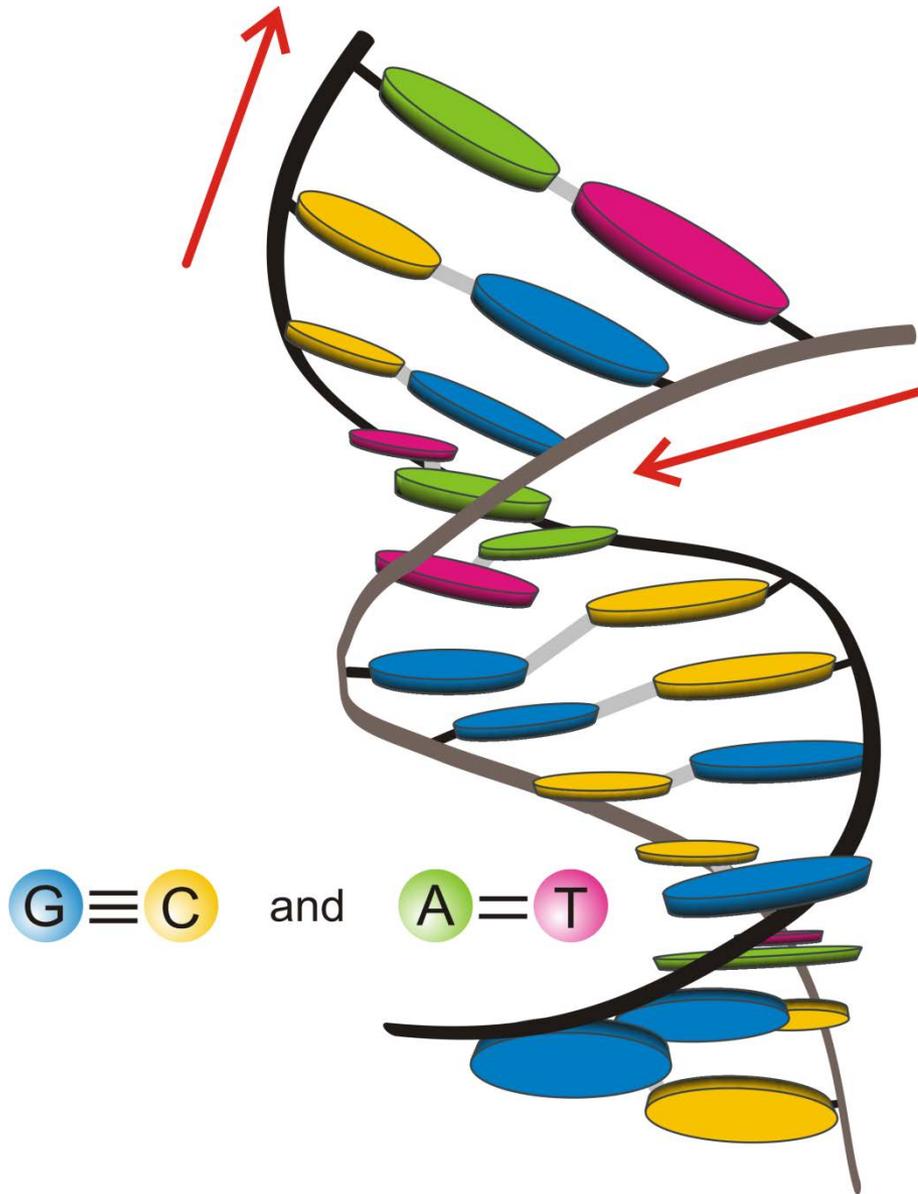
Genetic regulation networks of metabolism in drosophila



$$f_1 = 1, f_2 = 2, f_3 = 3, f_4 = 7$$

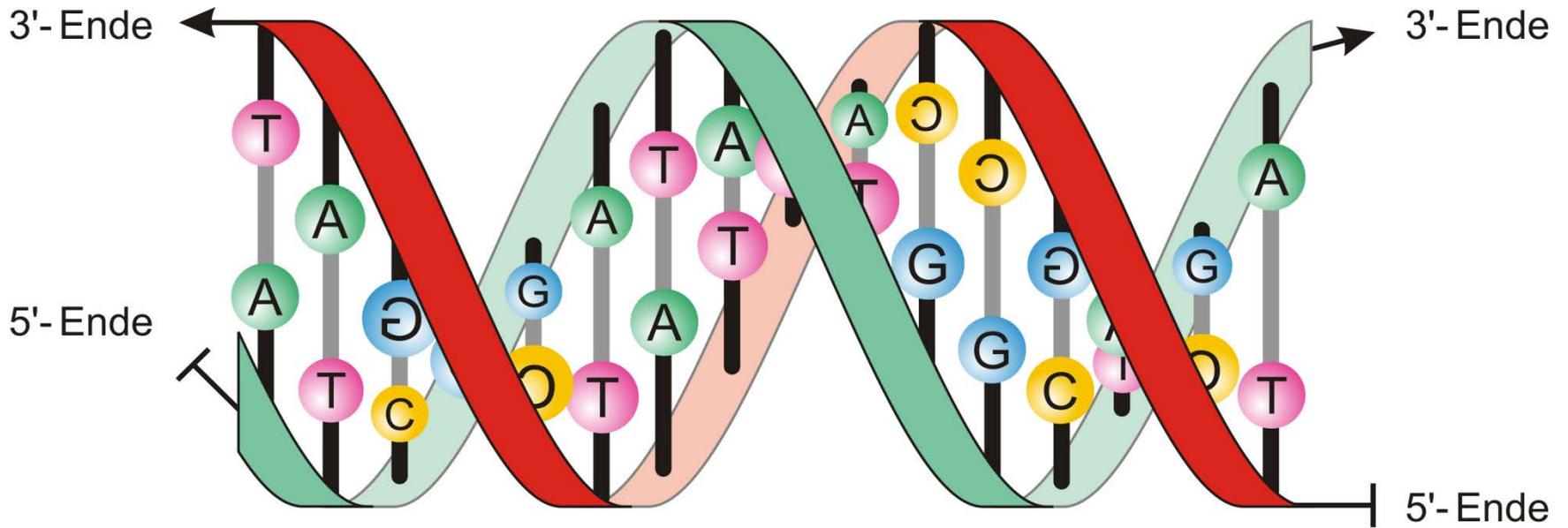
Vor der Entwicklung der Molekularbiologie wurde Mutation als ein "Deus ex Machina" behandelt

Die Brücke von der Chemie zur Biologie



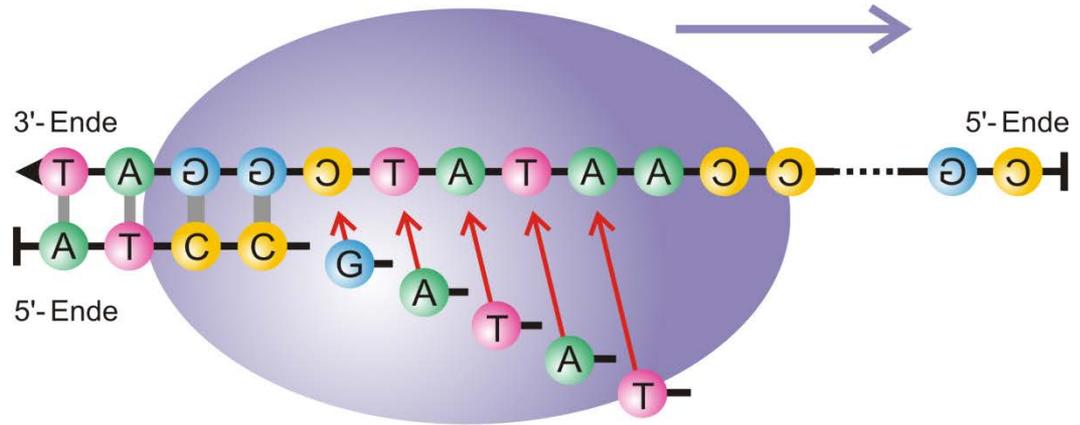
James D. Watson, 1928- , and Francis Crick, 1916-2004,
Nobel Preis 1962

Die dreidimensionale Struktur eines
kleinen Stückes der B-DNA



Die B-Form der DNA-Doppelhelix

Taq-Polymerase



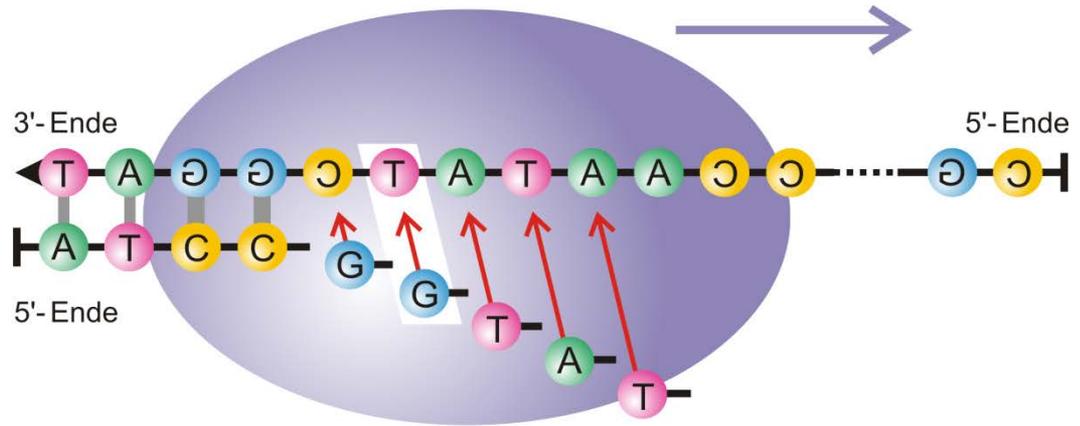
korrekte Replikation

Adenin 

Thymin 

Guanin 

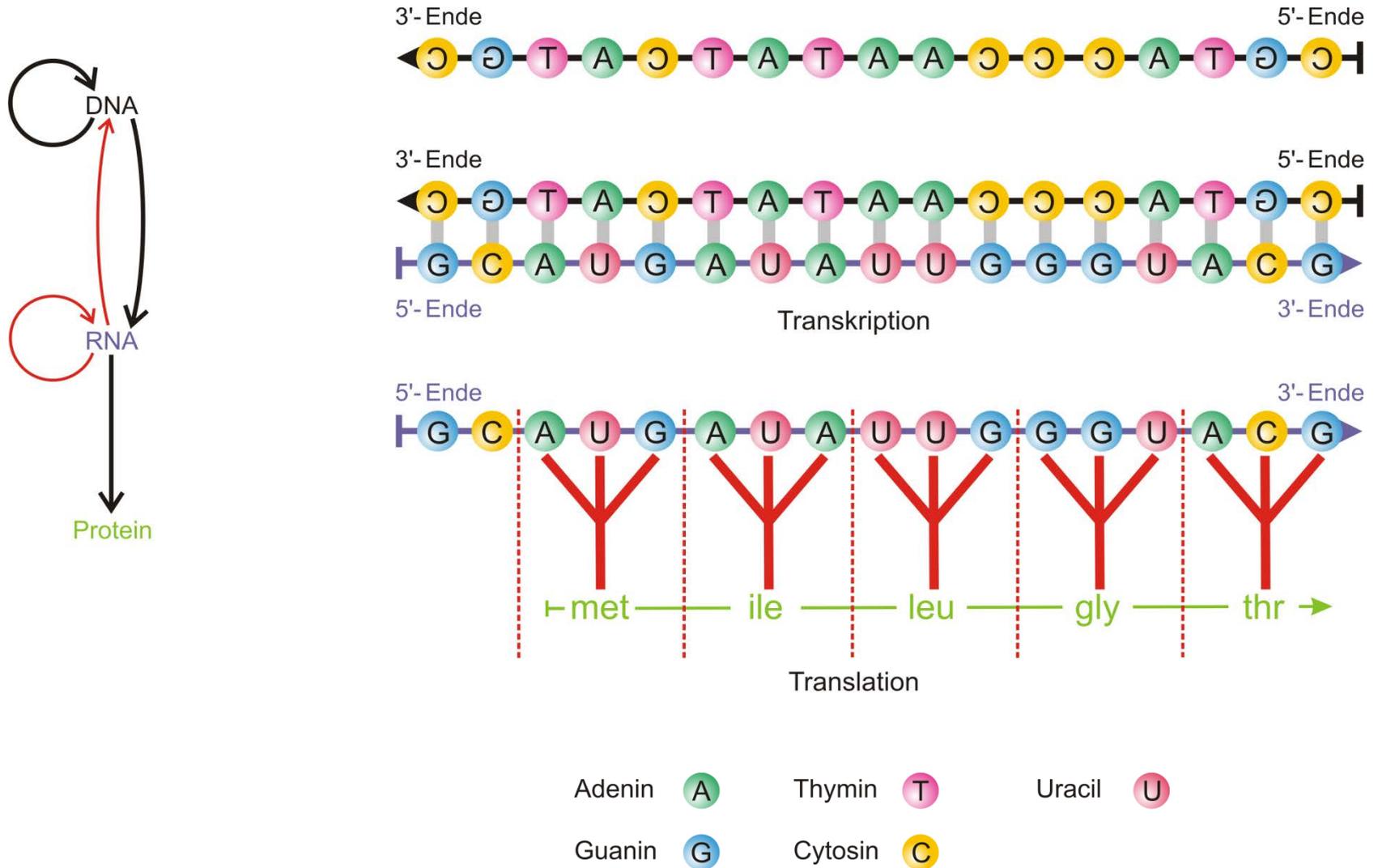
Cytosin 



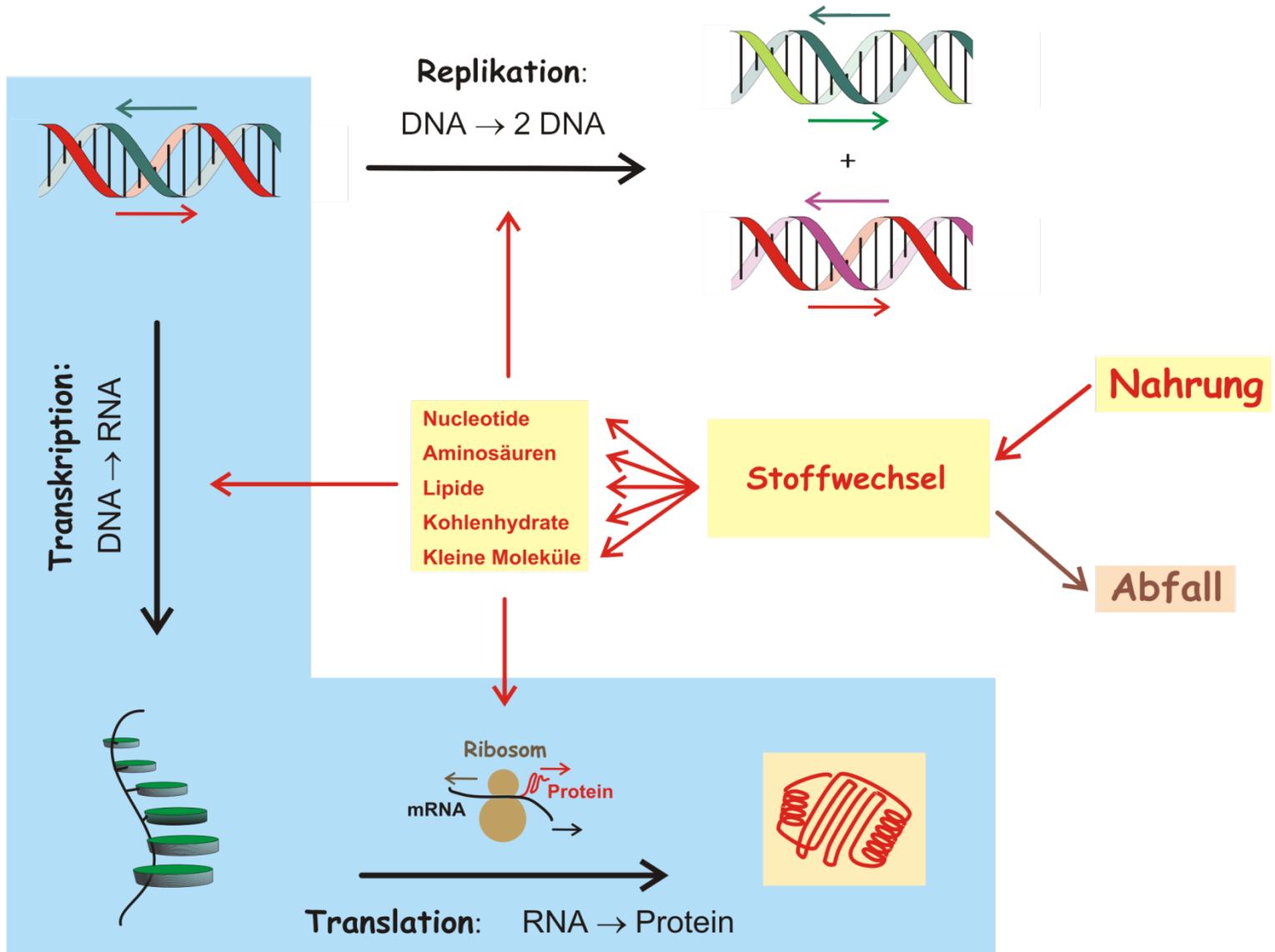
Mutation

Nukleotideinbaufehler: p ... Mutationsrate pro Position und Replikation

Korrekte Replikation und Punktmutation



The 'central dogma' of molecular biology



Evolutionsexperimente

Molecular Evolution

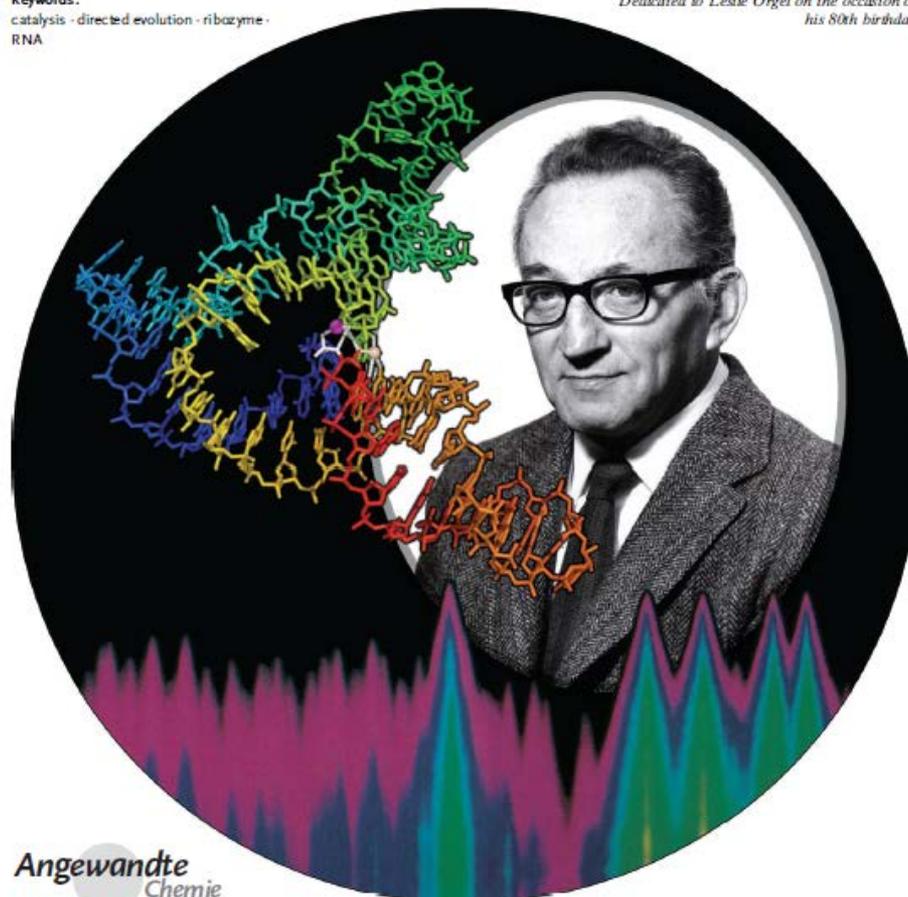
Forty Years of In Vitro Evolution**

Gerald F. Joyce*

Keywords:

catalysis · directed evolution · ribozyme · RNA

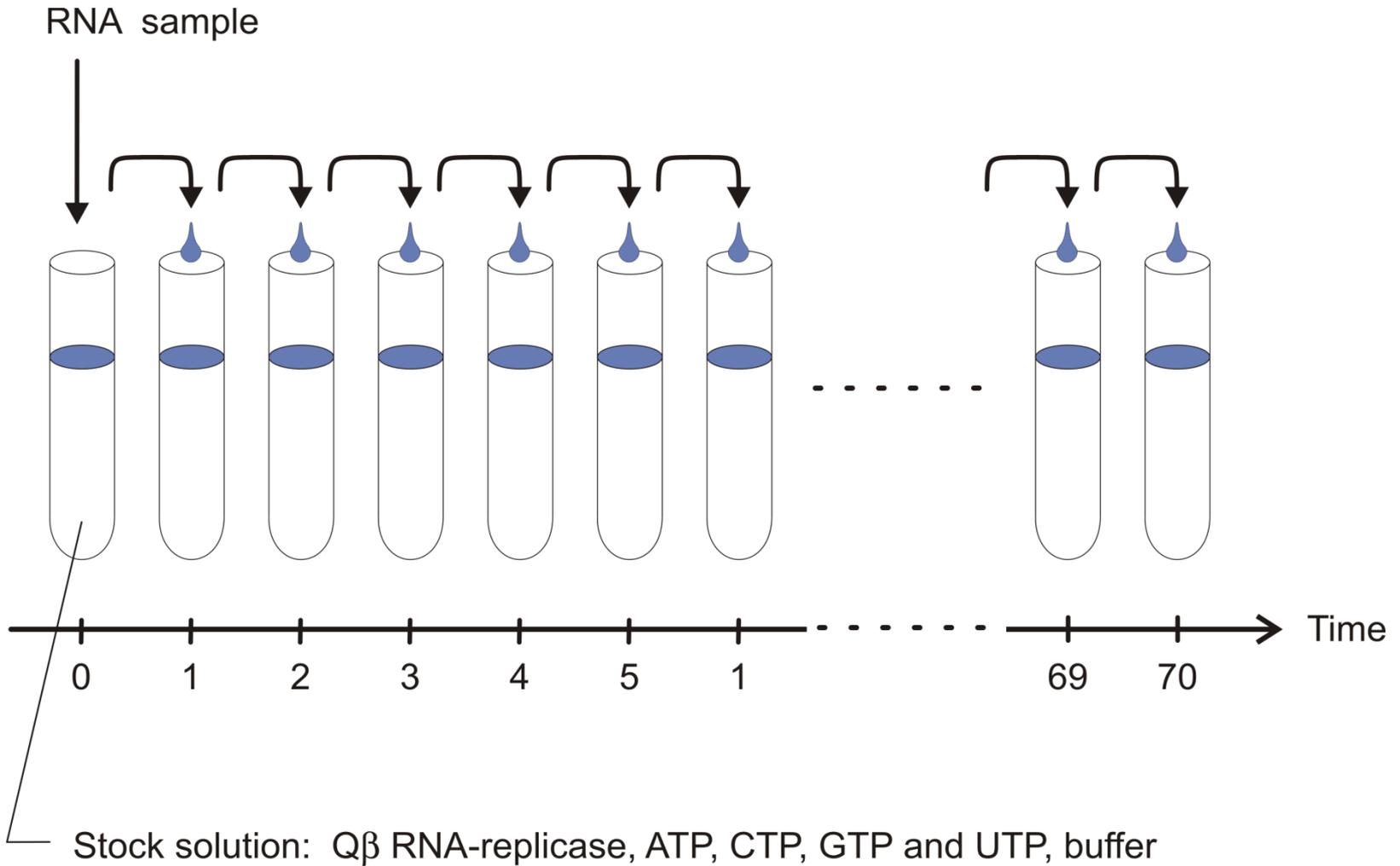
Dedicated to Leslie Orgel on the occasion of his 80th birthday



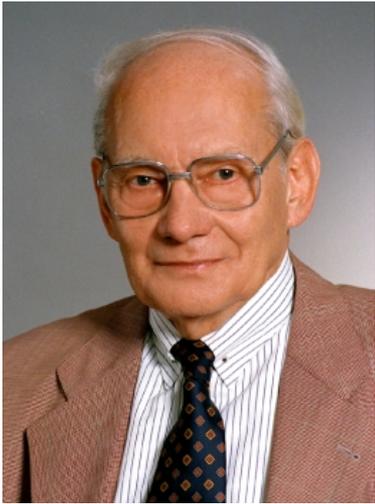
Sol Spiegelman,
1914 - 1983

Evolution im Reagenzglas:

G.F. Joyce, *Angew. Chem. Int. Ed.*
46 (2007), 6420-6436



Anwendung der Technik des seriellen Transfers zur Evolution von RNA im Reagenzglas



Manfred Eigen, 1927 -

DIE NATURWISSENSCHAFTEN

58. Jahrgang, 1971 Heft 10 Oktober

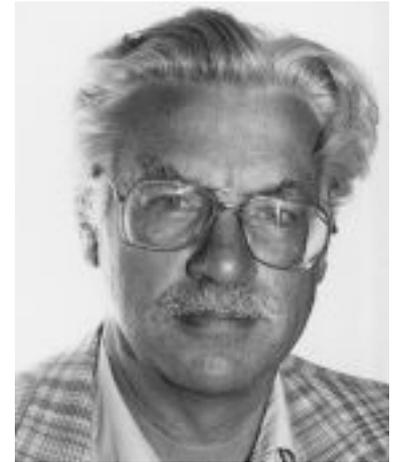
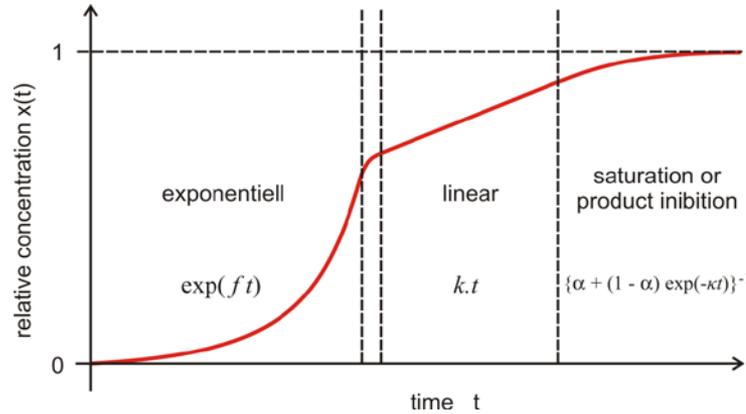
Selforganization of Matter and the Evolution of Biological Macromolecules

MANFRED EIGEN*
Max-Planck-Institut für Biophysikalische Chemie,
Karl-Friedrich-Bonhoeffer-Institut, Göttingen-Nikolausberg

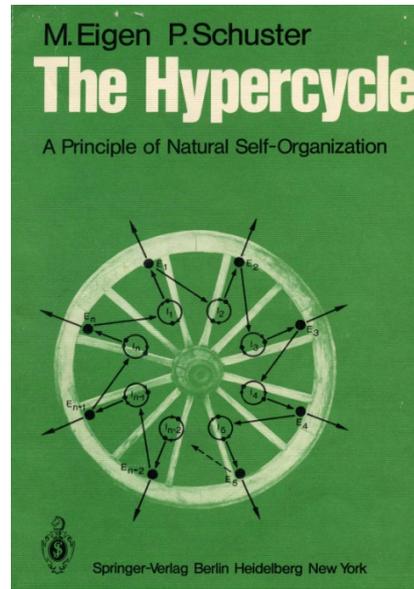
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I. Introduction
I.1. "Cause and Effect"
The question about the origin of life often appears as a question about "cause and effect". Physical theories of macroscopic processes usually involve answers to such questions, even if a statistical interpretation is given to the relation between "cause" and "effect". It is so many due to the nature of this question that many scientists believe that our present physics does not offer any obvious explanation for the existence of life.
* First presented as the "Robbins Lectures" at Pomona College, California, in Spring 1970.
© Springer-Verlag 1971

which even in its simplest form always appears to be associated with complex macromolecular (i.e. multimolecular) systems, such as the living cell.
As a consequence of the exciting discovery of the "molecular biology", a common version of the above question is: *Which came first, the protein or the nucleic acid?* - a popular variant of the old "chicken-and-egg" problem. The term "first" is usually meant to define a causal rather than a temporal relationship, and the words "protein" and "nucleic acid" may be substituted by "instructed" and "instructed". The question in this form, when applied to the laboratory of nucleic acids and proteins is presently encountered in the living cell, inside of organisms, because "function"



Christof K. Biebricher, 1941-2009



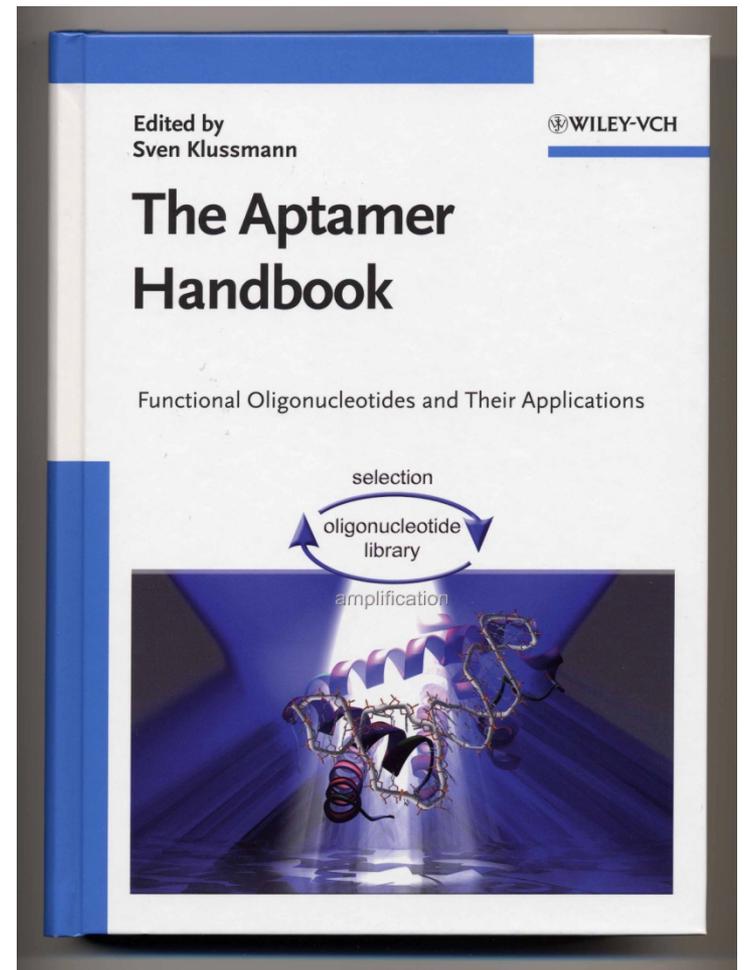
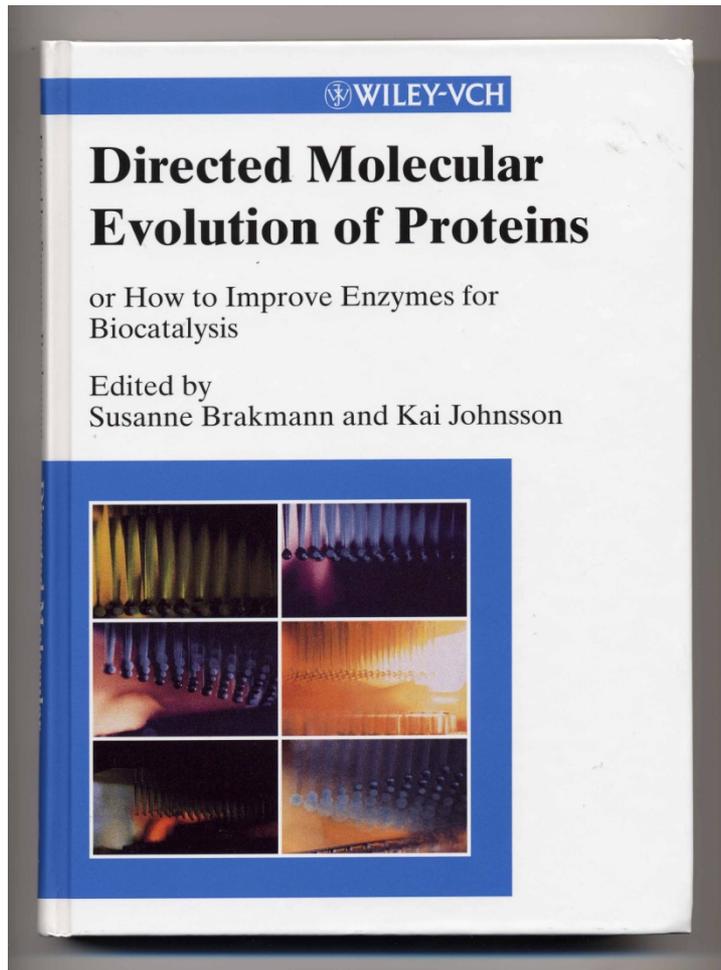
RNA Genetics. Vol. I: RNA-Directed Virus Replication.
E. Domingo, J. J. Holland, P. Ahlquist, Eds.
CRC Press, Boca Raton, Florida 1987, pp. 1-21.

Chapter 1
KINETICS OF RNA REPLICATION BY Q_β REPLICASE
Christof K. Biebricher and Manfred Eigen

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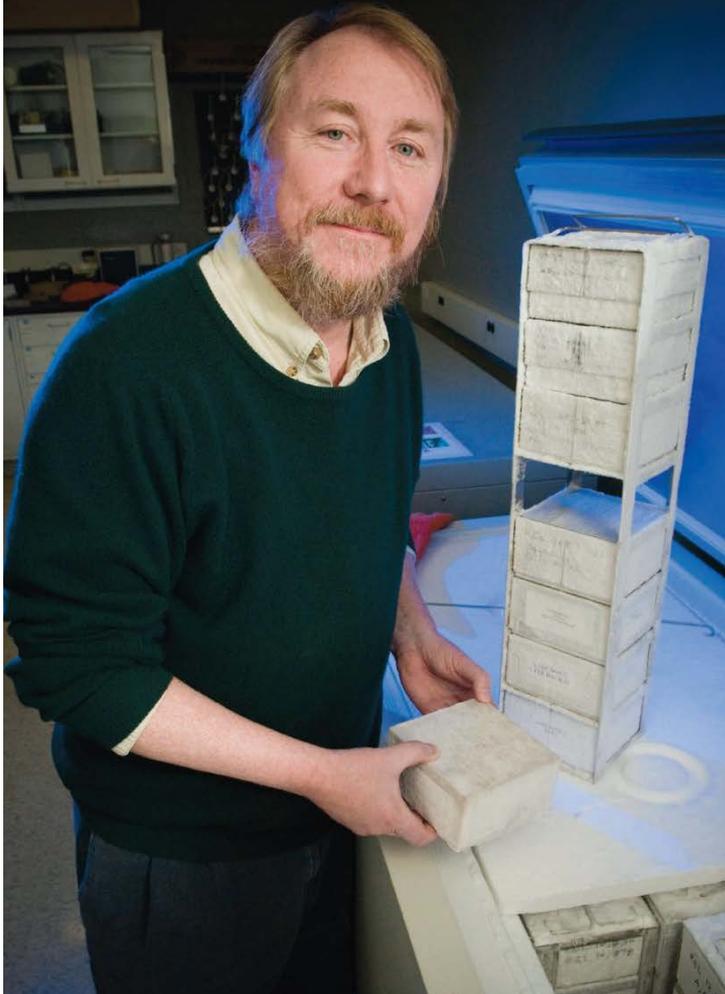
Chemische Kinetik der molekularen Evolution



Anwendungen der molekularen Evolution in der Biotechnologie

The Man Who Bottled Evolution

Richard Lenski's 25-year experiment in bacterial evolution shows no signs of running out of surprises about how mutation and selection shape living things



Nach 31500 Generationen entstand eine Variante die Zitrat metabolisieren konnte und einen großen Vorteil gegenüber den anderen hatte.

Richard Lenski:

60 000 Generationen *Escherichia coli* in nicht ganz 30 Jahren entsprechen ungefähr 1 Million Jahre humaner Evolution

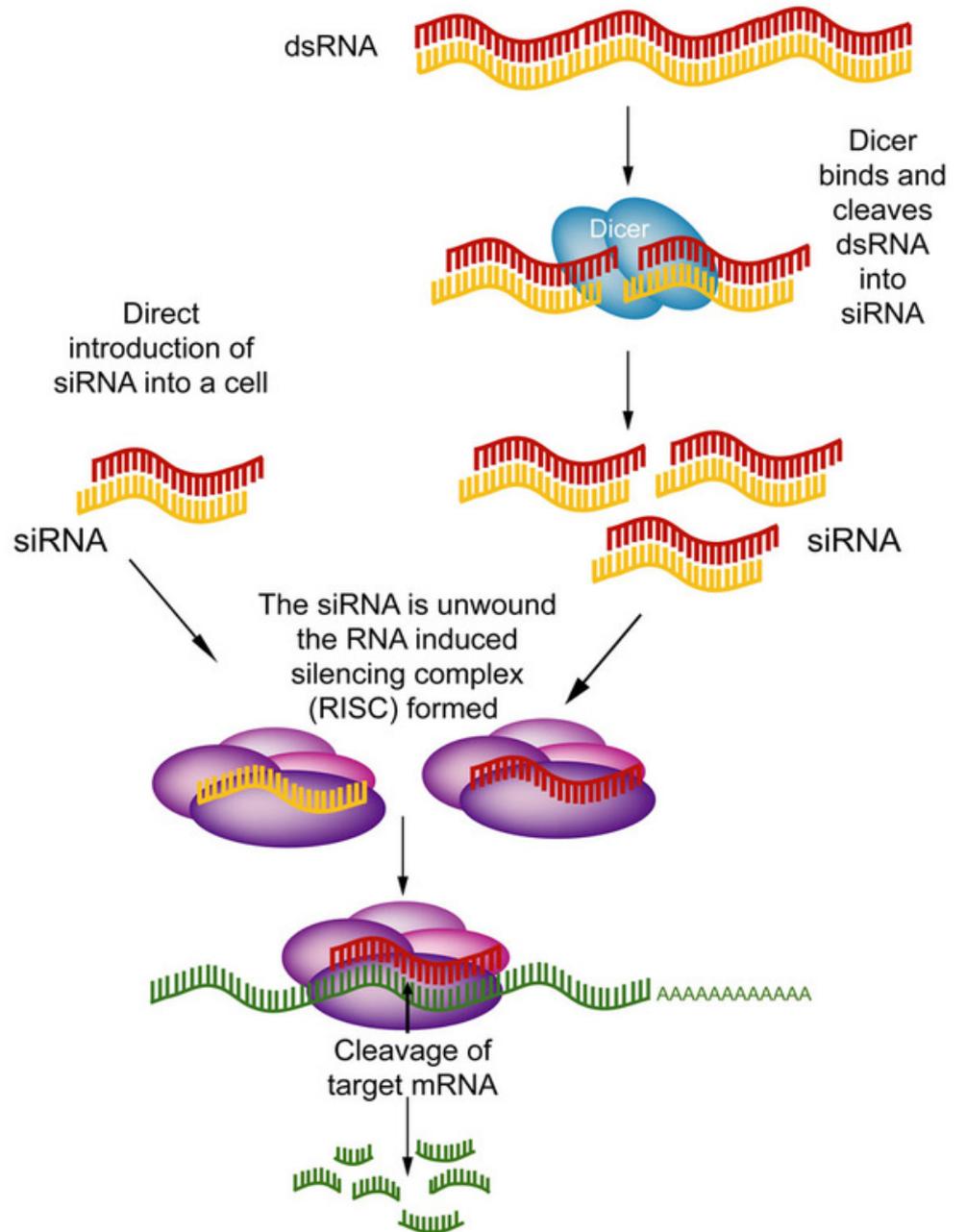
Science 342(6061):790-793, 2017

Molekulare Genetik im 21. Jahrhundert

Die Erforschung von Phänomenen und Mechanismen,
die erhebliche Veränderungen an Chromosomen
hervorrufen und die Aktivität von Genen beeinflussen,
ohne die Sequenz der DNA zu verändern.

Eine mögliche Definition von Epigenetik

RISC = RNA-induced silencing complex

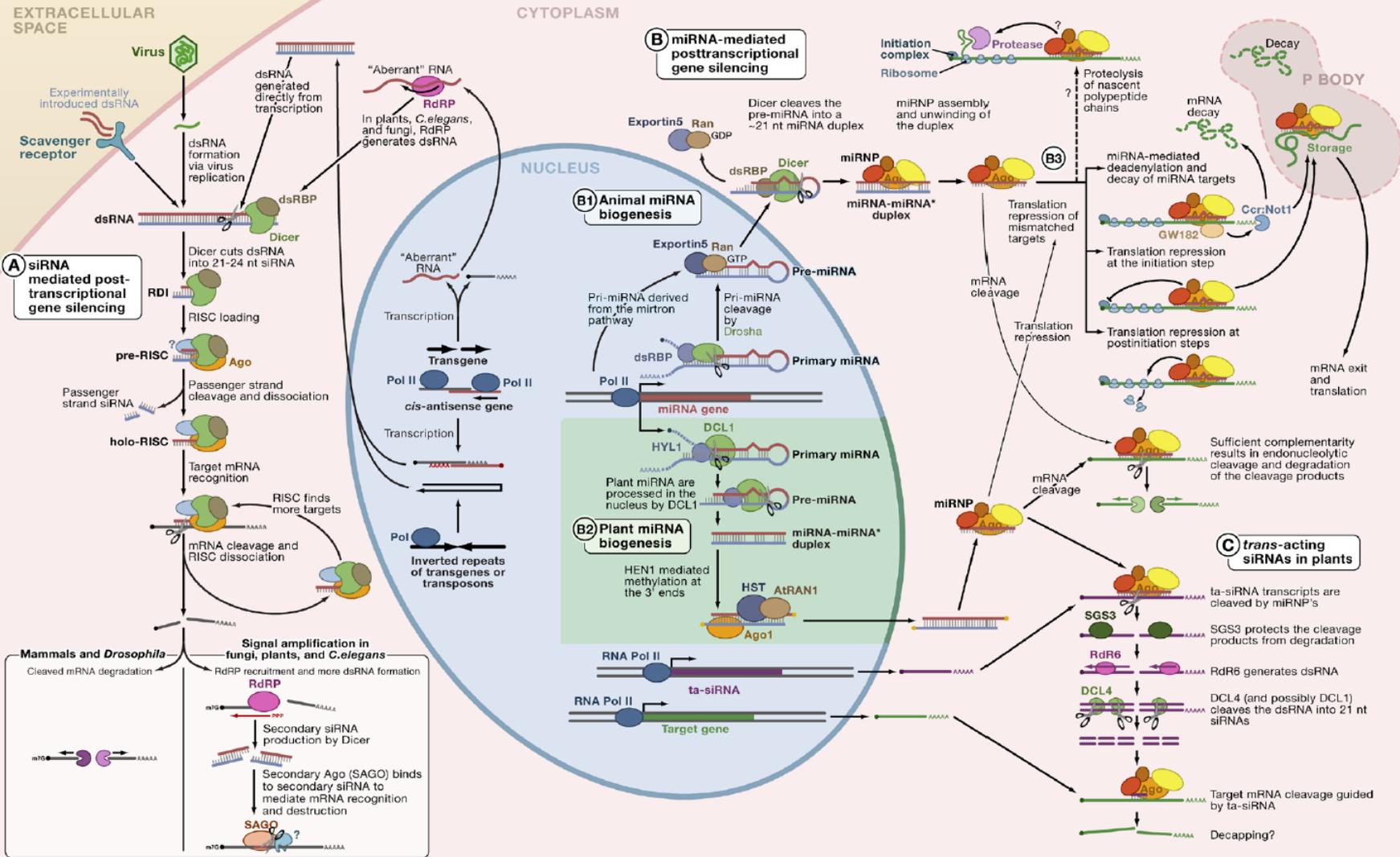


RNA-Interferenz und Spaltung von mRNA

SnapShot: Posttranscriptional Gene Silencing

Sigal Pressman, Yanxia Bei, and Richard Carthew

Department of Biochemistry, Molecular Biology and Cell Biology, Northwestern University, Evanston, IL 60208, USA



Was von Darwin 158 Jahre nach der
„Origin of Species“ geblieben ist.

Danke für die Aufmerksamkeit!

Web-Page for further information:

<http://www.tbi.univie.ac.at/~pks>

