

Vorlesung „Allgemeine Biologie für Informatiker und Mathematiker 1“

Teil Genetik 1

Wintersemester 2000/2001

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1. Vererbung und Variabilität

- 1.1 Umweltbedingte Variabilität**
- 1.2 Genetisch bedingte Variabilität**
- 1.3 Phänokopien**

2. Vererbung als biologisches Grundphänomen

- 2.1 Die Mendelschen Regeln**
- 2.2 Mendel aus heutiger Sicht**
- 2.3 Ergänzungen zu den Mendelschen Regeln**

3. Die Chromosomentheorie der Vererbung

- 3.1 Die eukaryotische Zelle**
- 3.2 Der Zellzyklus – Mitose**
- 3.3 Der Zellzyklus – Meiose**
 - 3.3.1 Meiose I**
 - 3.3.2 Meiose II**
- 3.4 Lebenszyklen von Eukaryoten**
- 3.5 Das eukaryotische Chromosom – Crossing over und Kartierung**
- 3.6 Der Karyotyp**
- 3.7 Geschlechtschromosomen**
- 3.8 Polytäre Chromosomen (Riesenchromosomen)**
- 3.9 Extrachromosomale Gene**

4 Grundlagen menschlicher Vererbung

4.3 Stammbaumforschung

4.4 Erbkrankheiten – geschlechtsgebundene Gene

4.5 Menschliche Erbkrankheiten – Autosomale Gene

4.5.2 Rezessive Allele

4.5.3 Dominante Allele

4.6 Genetische, meist nichterbliche Krankheiten

4.6.2 Autosomale Aberrationen

4.6.3 Geschlechtschromosomenaberrationen

4.7 Genetische Familienberatung

4.8 Früherkennung von Erbkrankheiten

4.8.2 Cytologische Untersuchungen

4.8.3 Biochemische Methoden

4.9 Dosiskompensation – die Lyon-Hypothese

4.10 Genomische Prägung (Imprinting)

4.11 Genomprojekte

5. Molekulare Grundlagen der Vererbung

5.1 DNA als Träger der Erbinformation

5.2 Die Verdopplung des Erbmateri als (Replikation)

5.3 DNA-Schäden und Reparatur

5.3.1 Die Photoreaktivierung

5.3.2 Die Exzisionsreparatur

5.3.3 Die Nachreplikationsreparatur

5.3.4 Die SOS-Reparatur

5.4 Defekte im Reparatursystem

5.5 Mutationen

5.6 Mutagenitätstests

5.7 Veränderung des genetischen Materials durch Rekombination

5.7.1 Durch allgemeine Rekombination entsteht Crossing-over zwischen Chromosomen

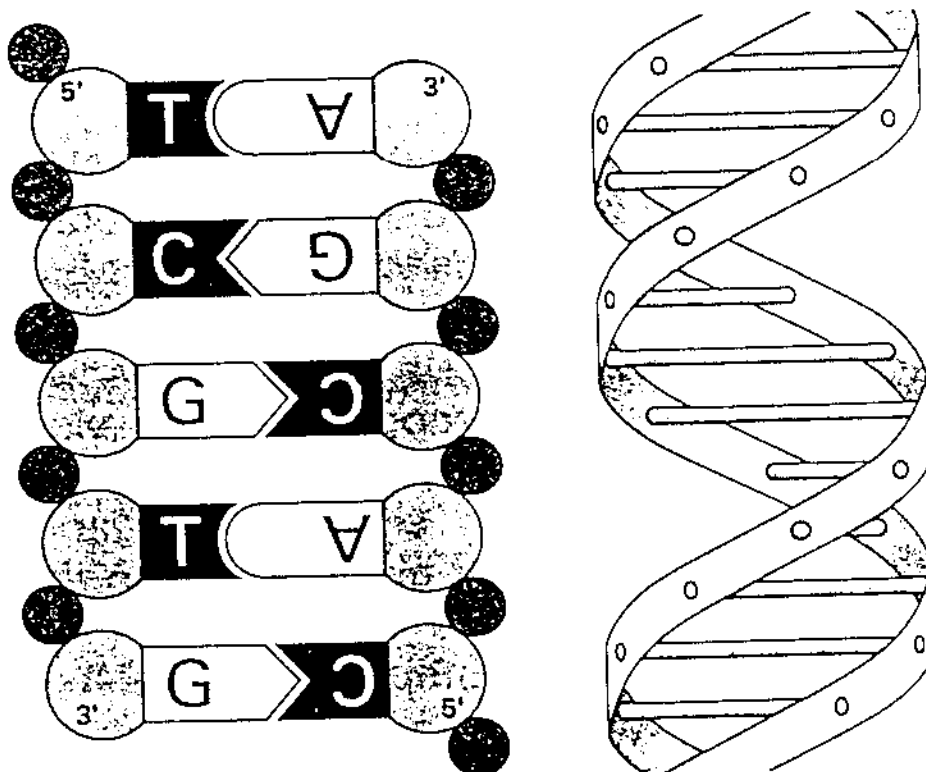
5.7.2 Sequenzspezifische Rekombination zwischen ringförmigen DNA-Molekülen

5.7.3 Transposition

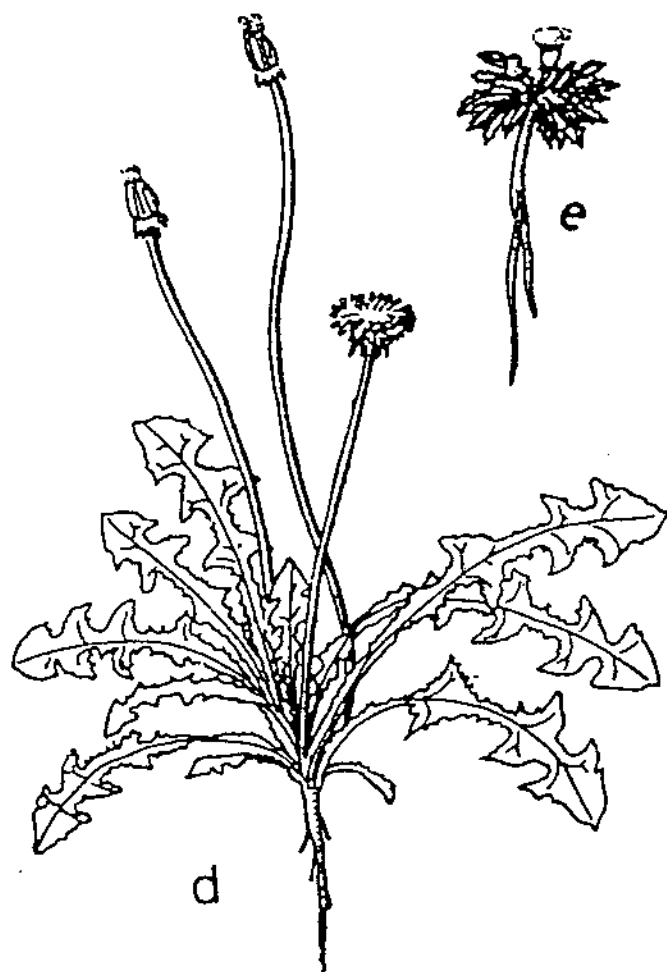
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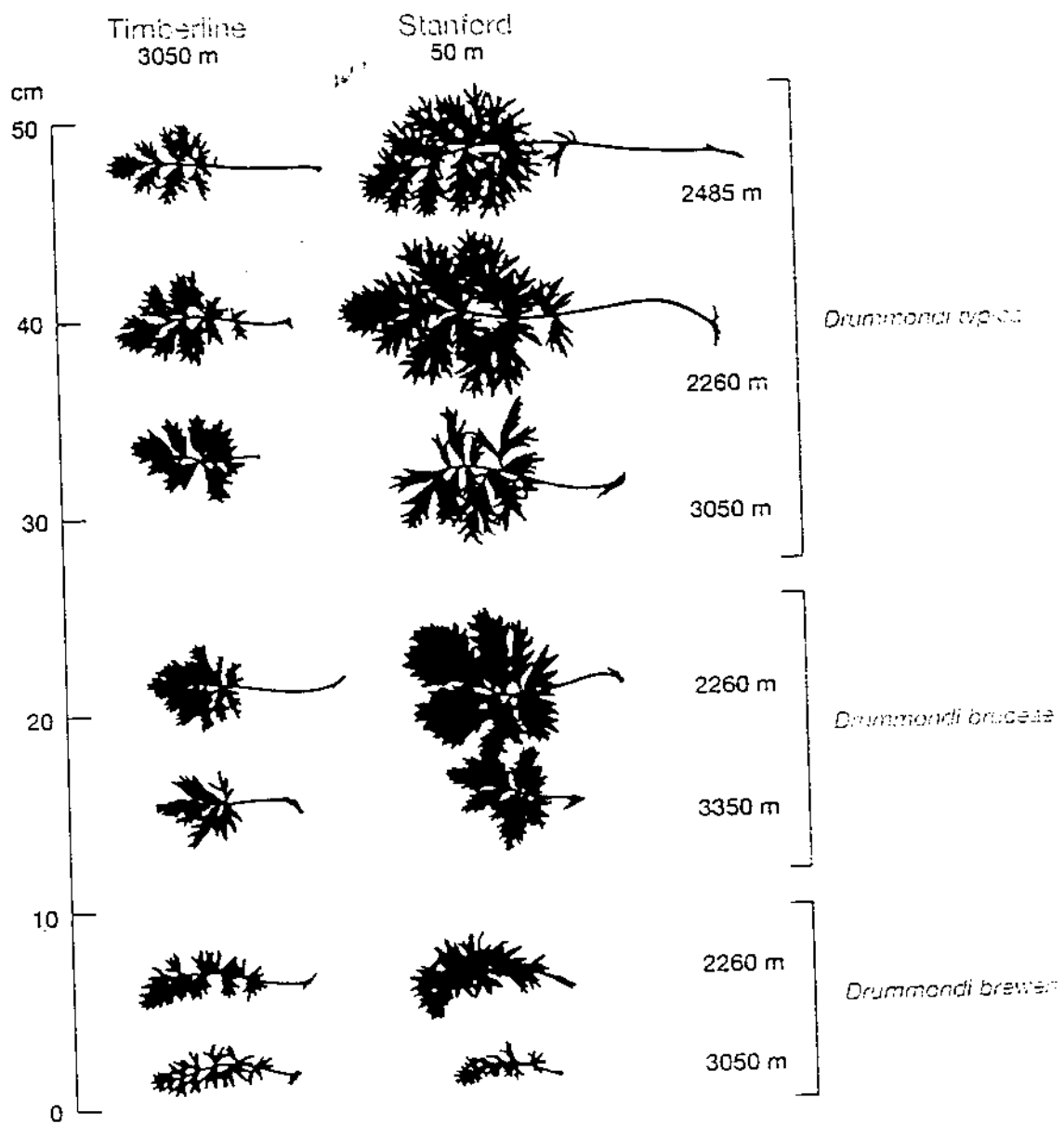








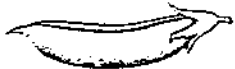





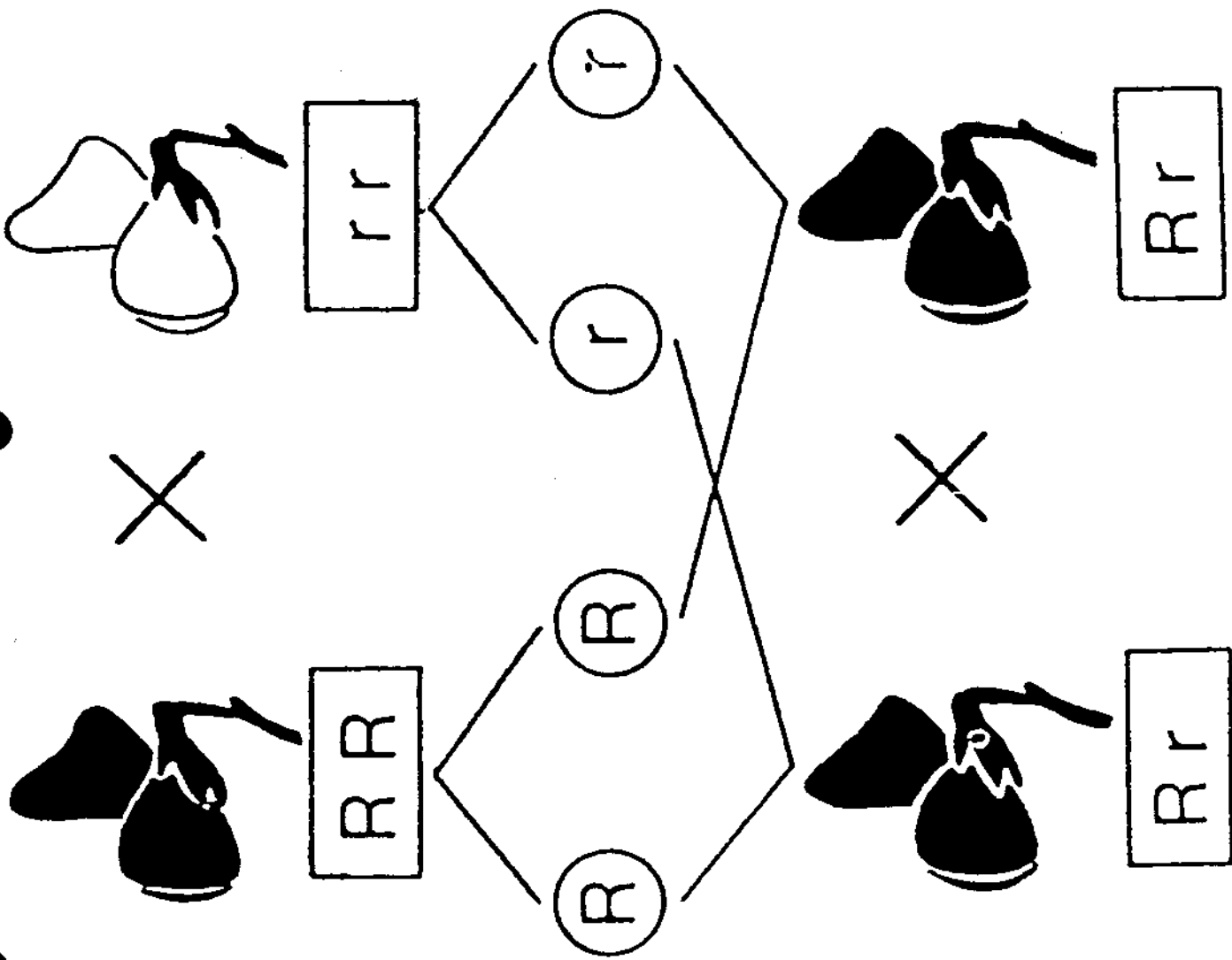


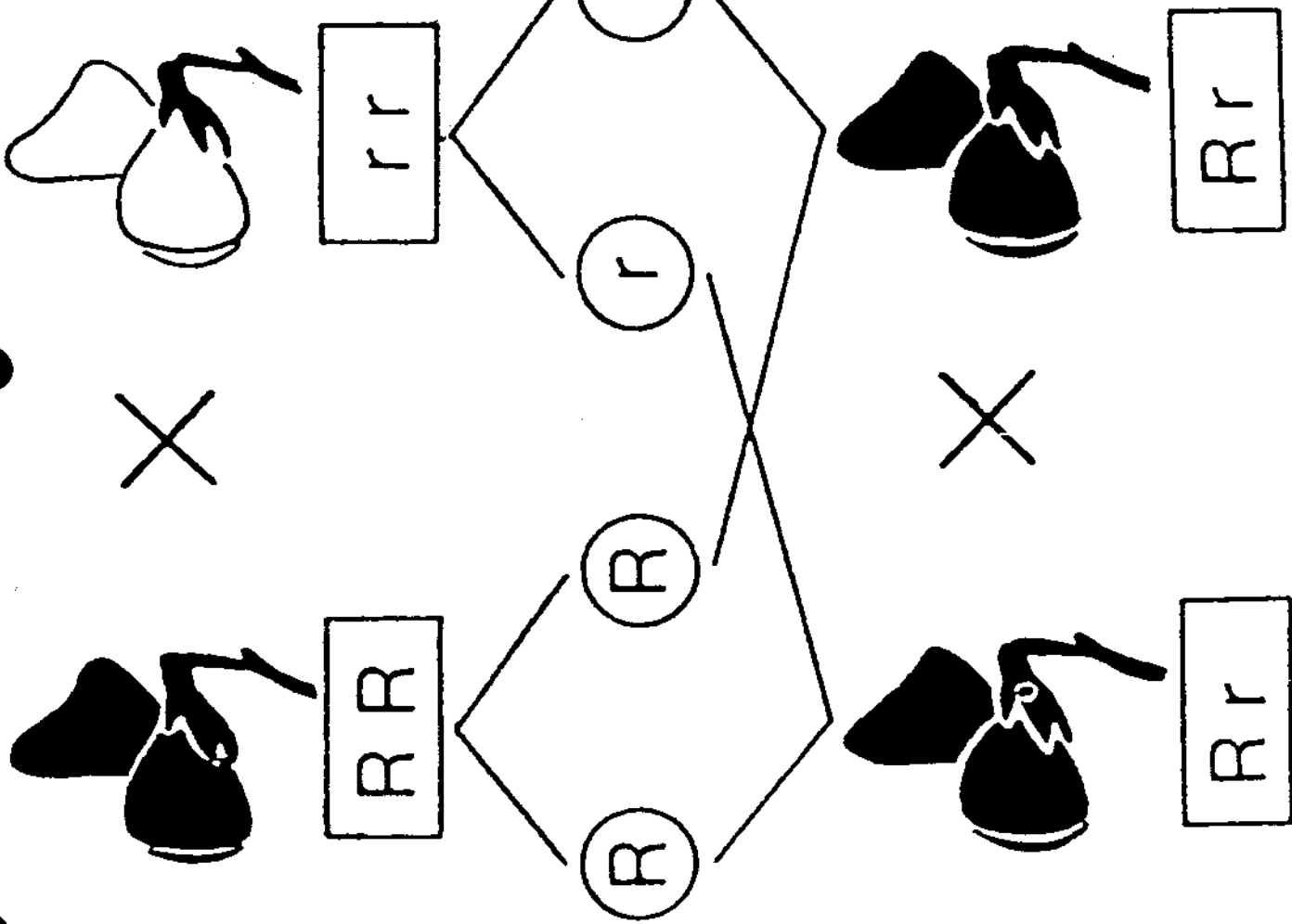
Tabelle 13.1: Die Ergebnisse der F₁-Kreuzungen Mendels mit sieben Merkmalen der Gartenerbse

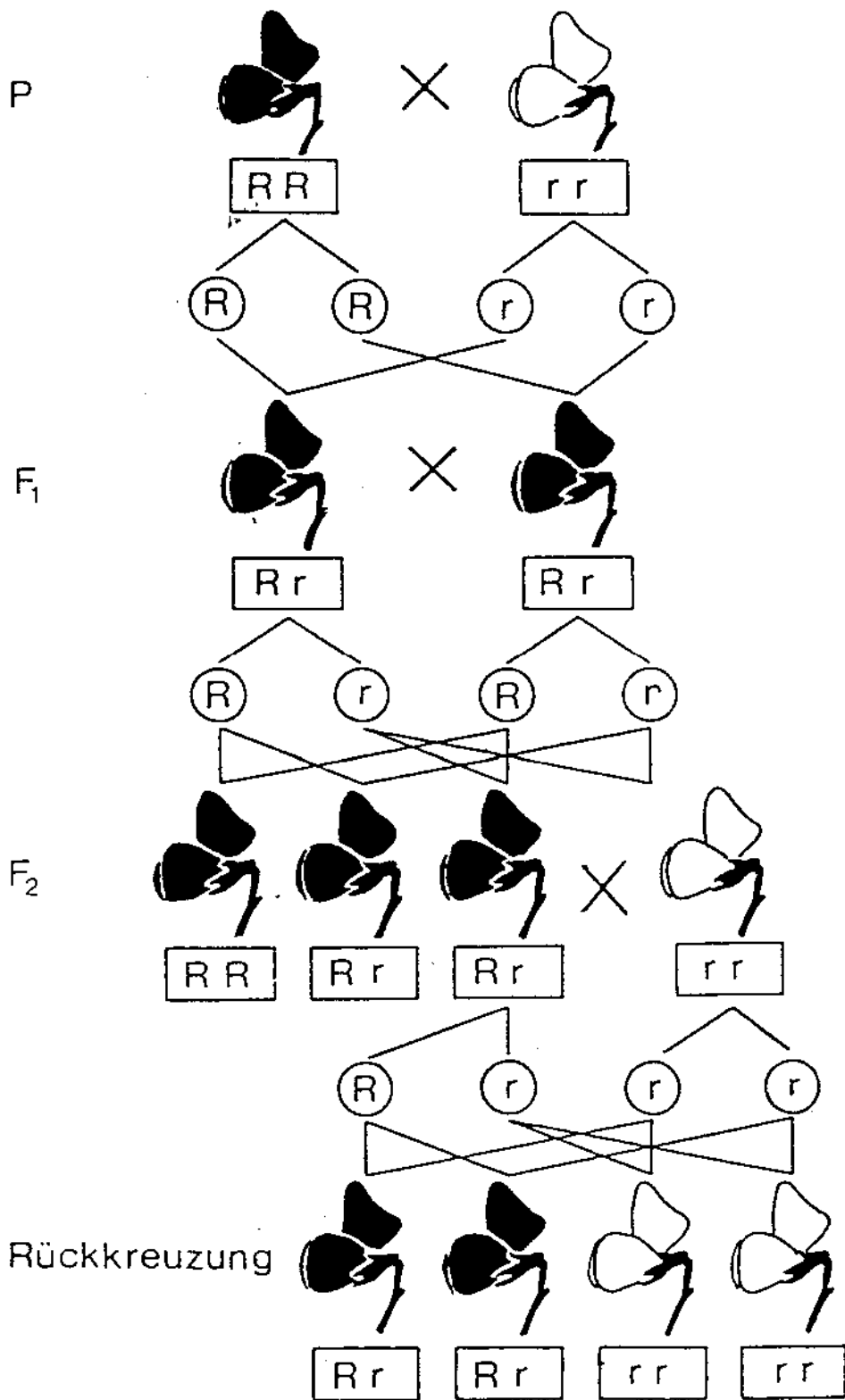
Merkmal	dominantes Allel	rezessives Allel	F ₂ -Generation dominant : rezessiv	Verhältnis
Blütenfarbe	 purpurfarben	 weiß	705 : 224	3,15 : 1
Blütenstellung	 axial	 terminal	651 : 207	3,14 : 1
Samenfarbe	 gelb	 grün	6022 : 2001	3,01 : 1
Samenform	 rund	 runzlig	5474 : 1850	2,96 : 1
Hülsenform	 aufgebläht	 eingeschnürt	882 : 299	2,95 : 1
Hülsenfarbe	 grün	 gelb	428 : 152	2,82 : 1
Stengellänge	 hoch	 kurz	787 : 277	2,84 : 1

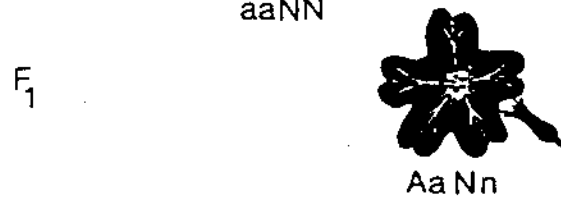
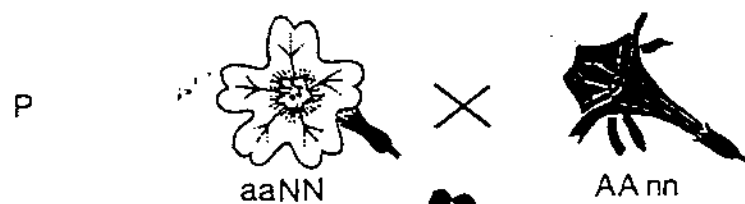
P



F₁

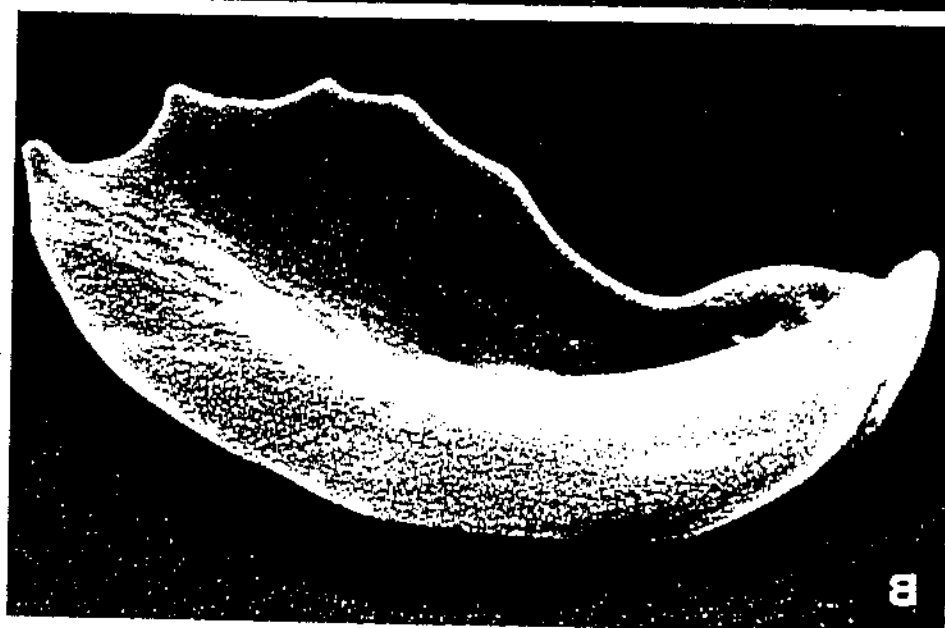
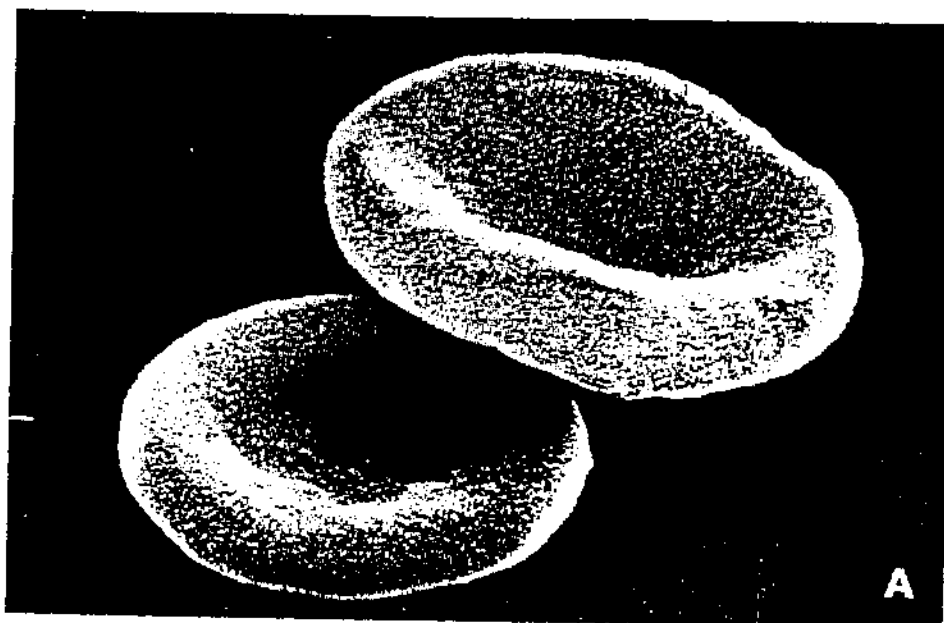


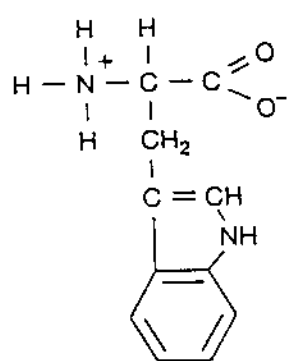




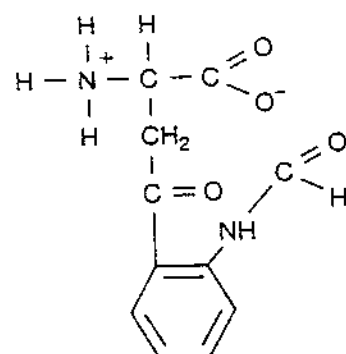
F ₂	AN	aN	An	an
AN	 AA NN	 Aa NN	 AA Nn	 Aa Nn
aN	 Aa NN	 aa NN	 Aa Nn	 aa Nn
An	 AA Nn	 Aa NN	 AA nn	 Aa nn
an	 Aa Nn	 aa Nn	 Aa nn	 aa nn

Genotyp	Oberflächen- Antigen	Antikörper- bildung
I^A/I^A oder I^A/I^0	A	Anti-B
I^B/I^B oder I^B/I^0	B	Anti-A
I^A/I^B	A und B	keine
I^0/I^0	keine	Anti-A und Anti-B

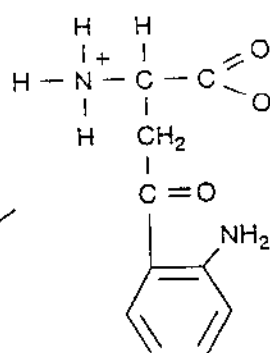




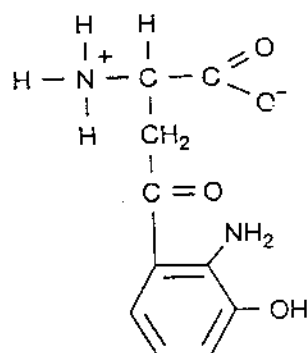
L-Tryptophan



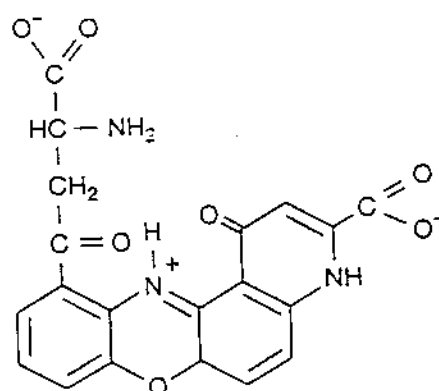
N-Formylkynurenin



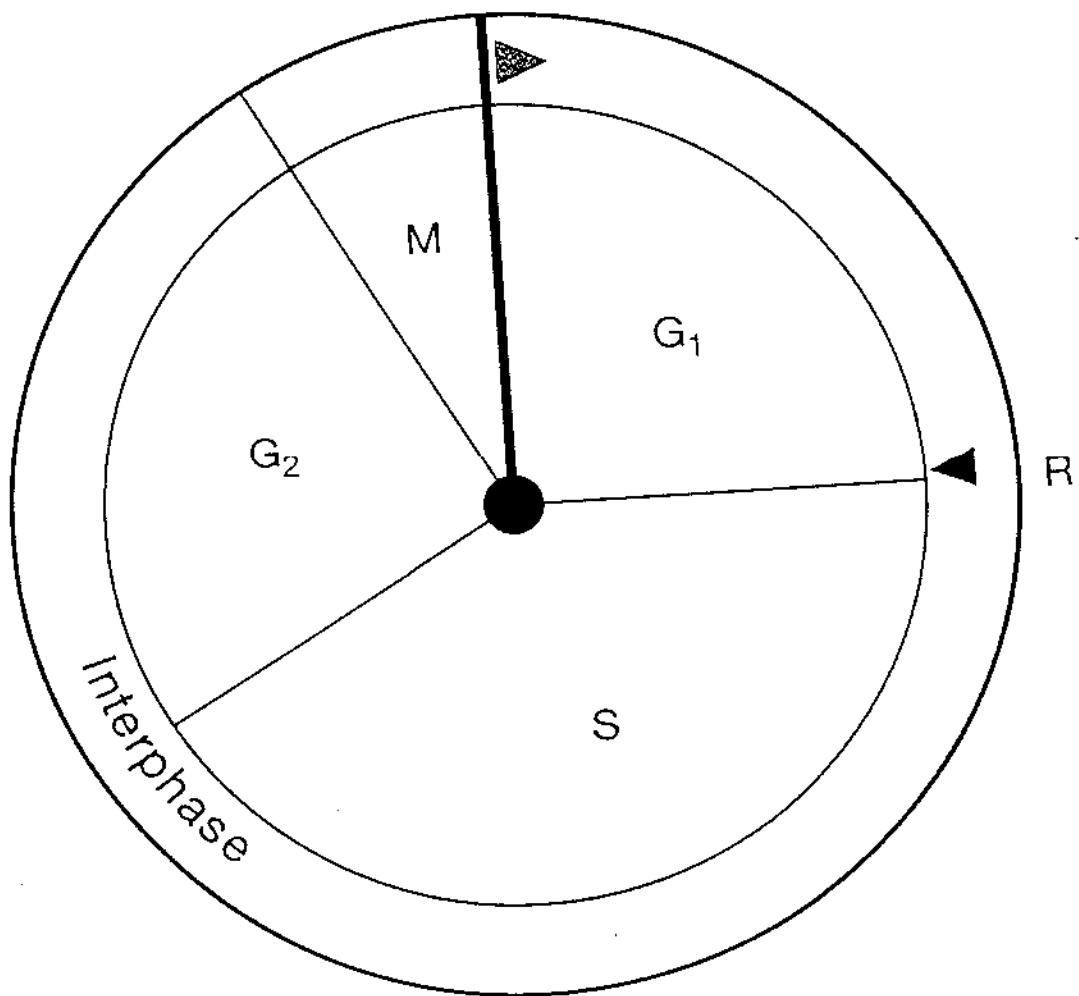
Kynurenin

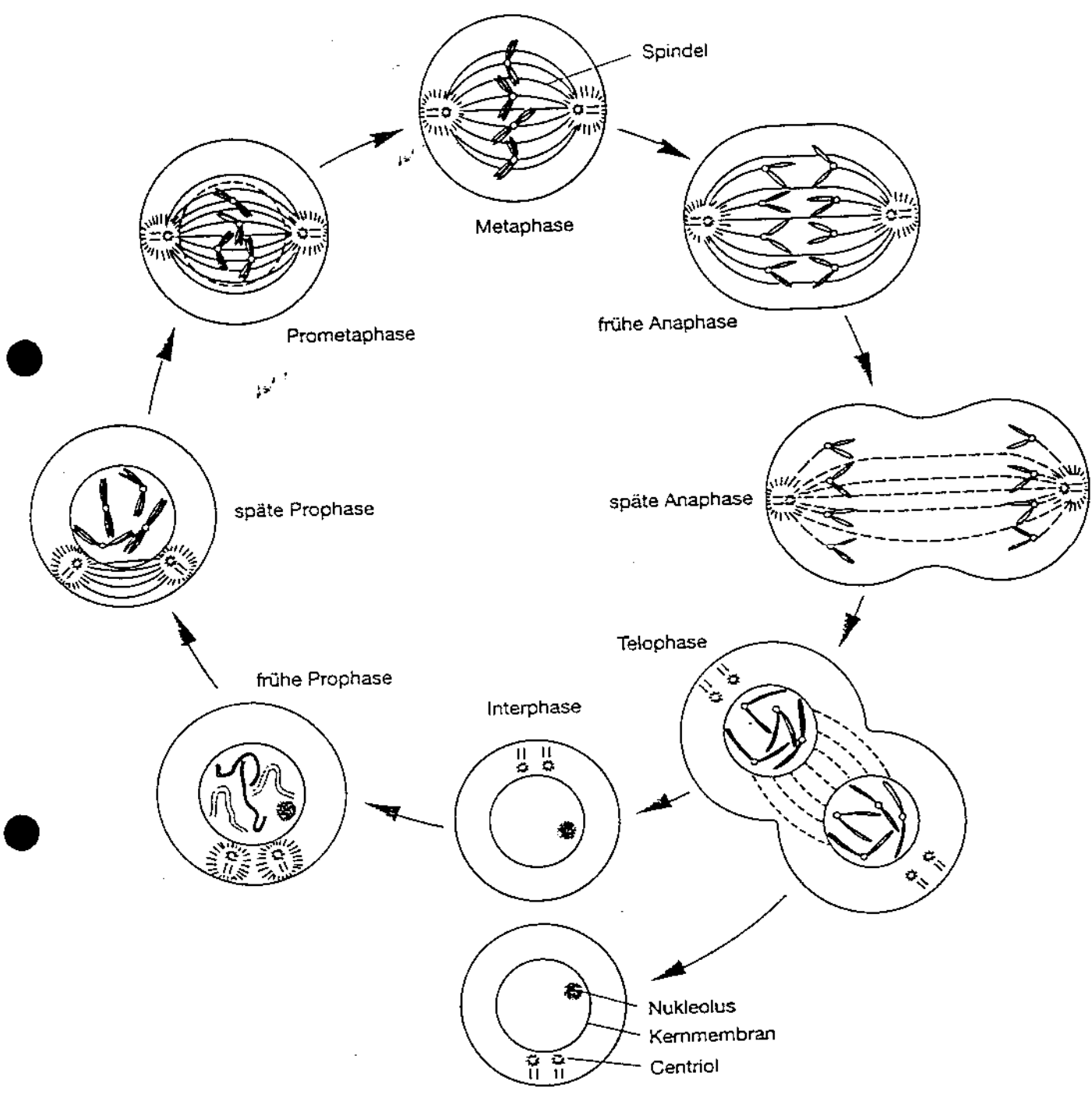


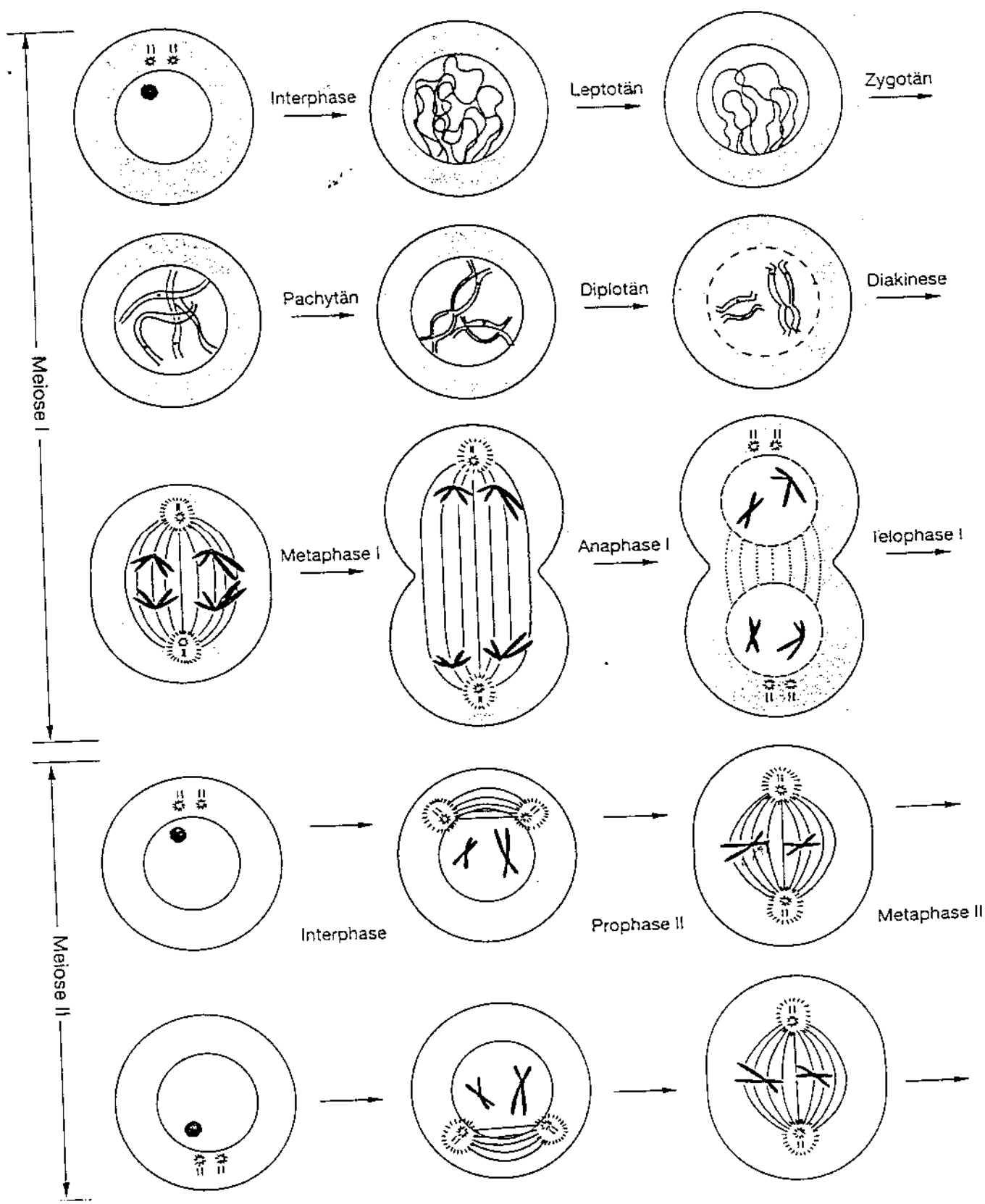
3-Hydroxykynurenin

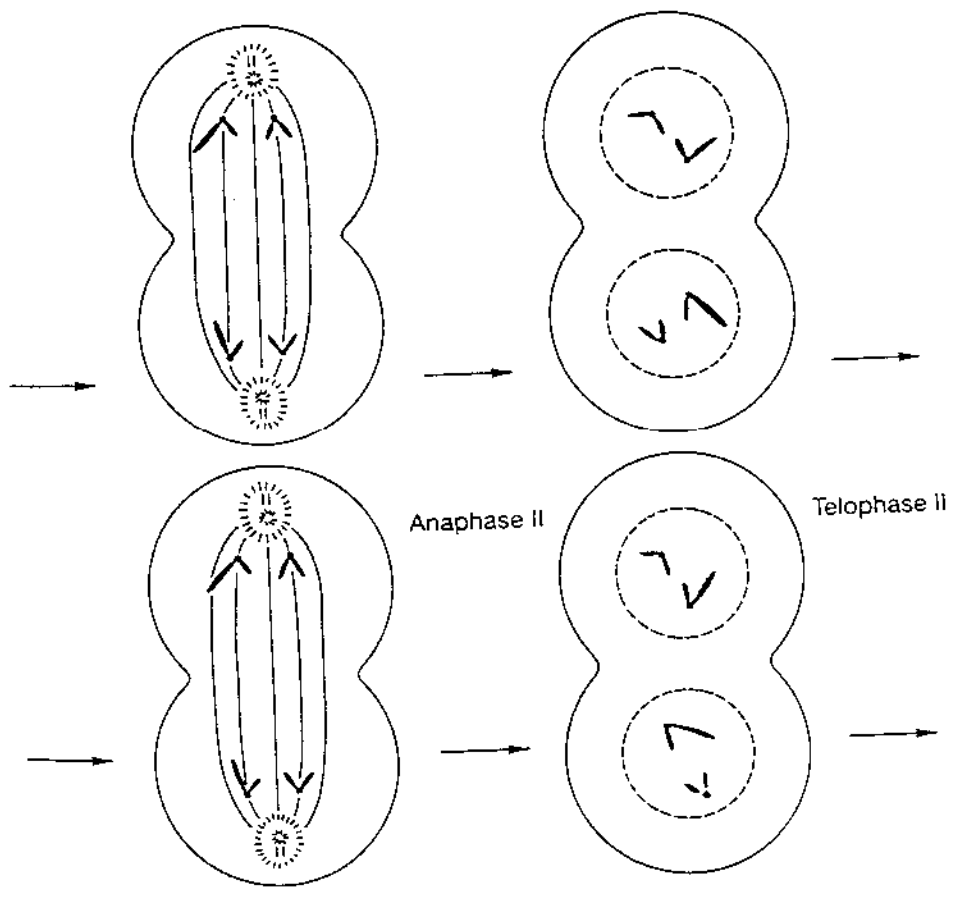


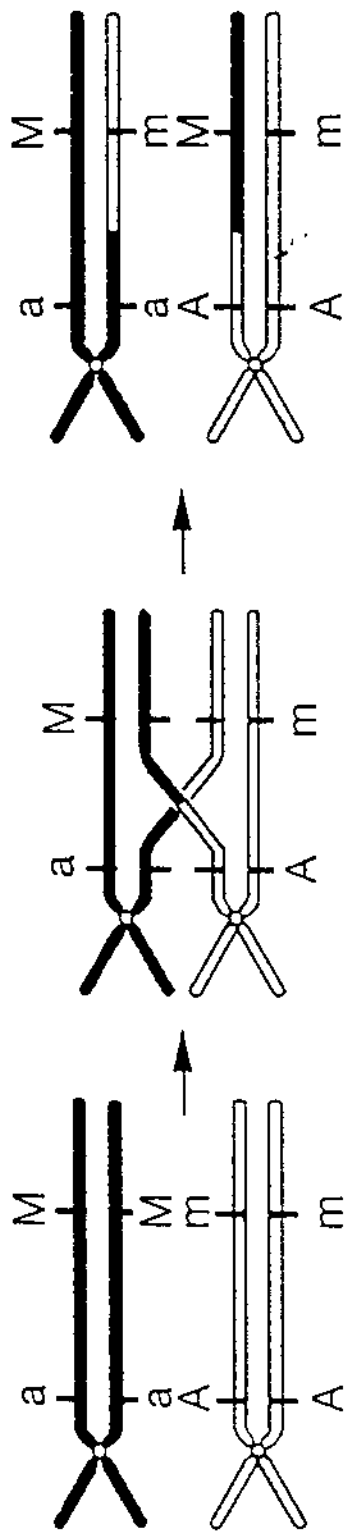
Xanthommatin



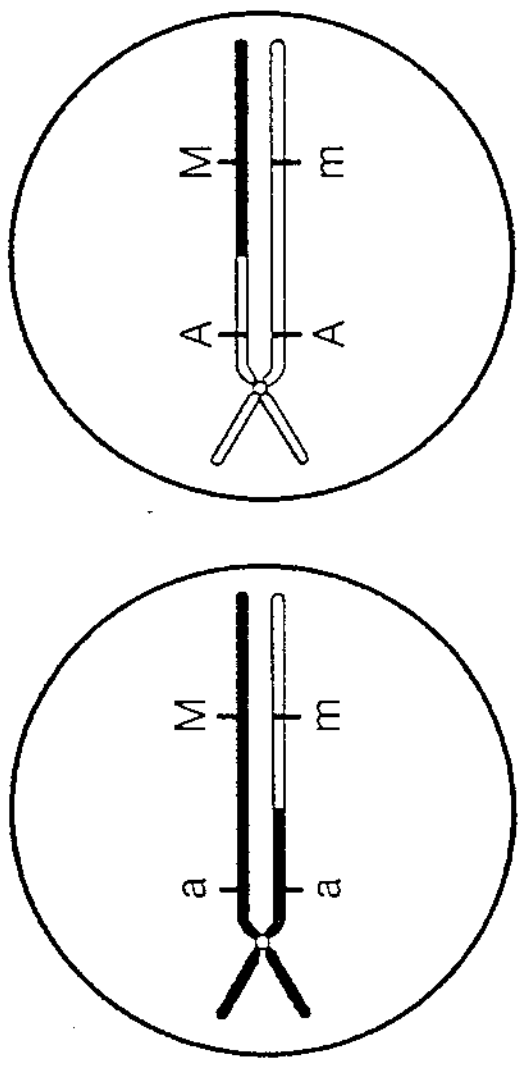




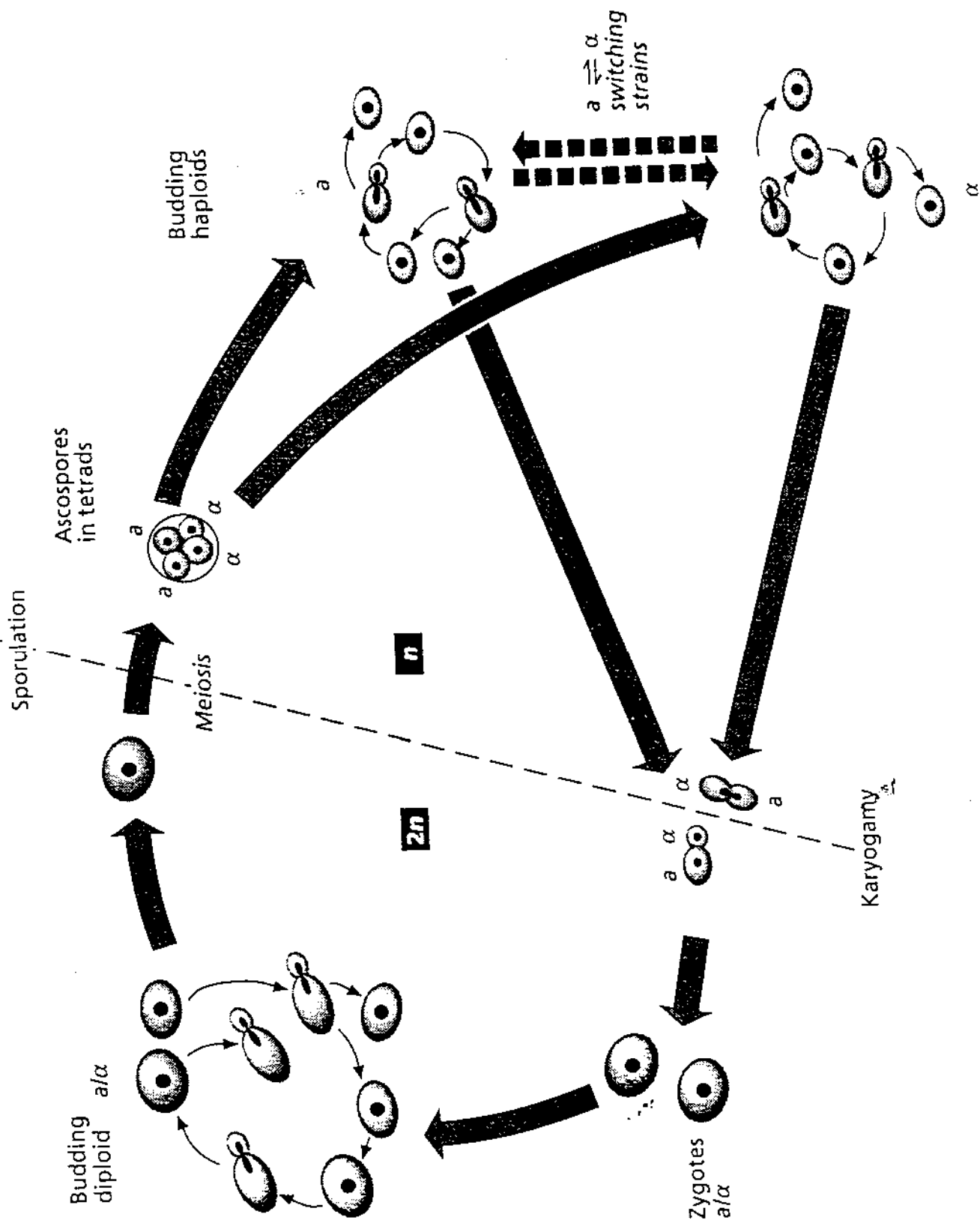


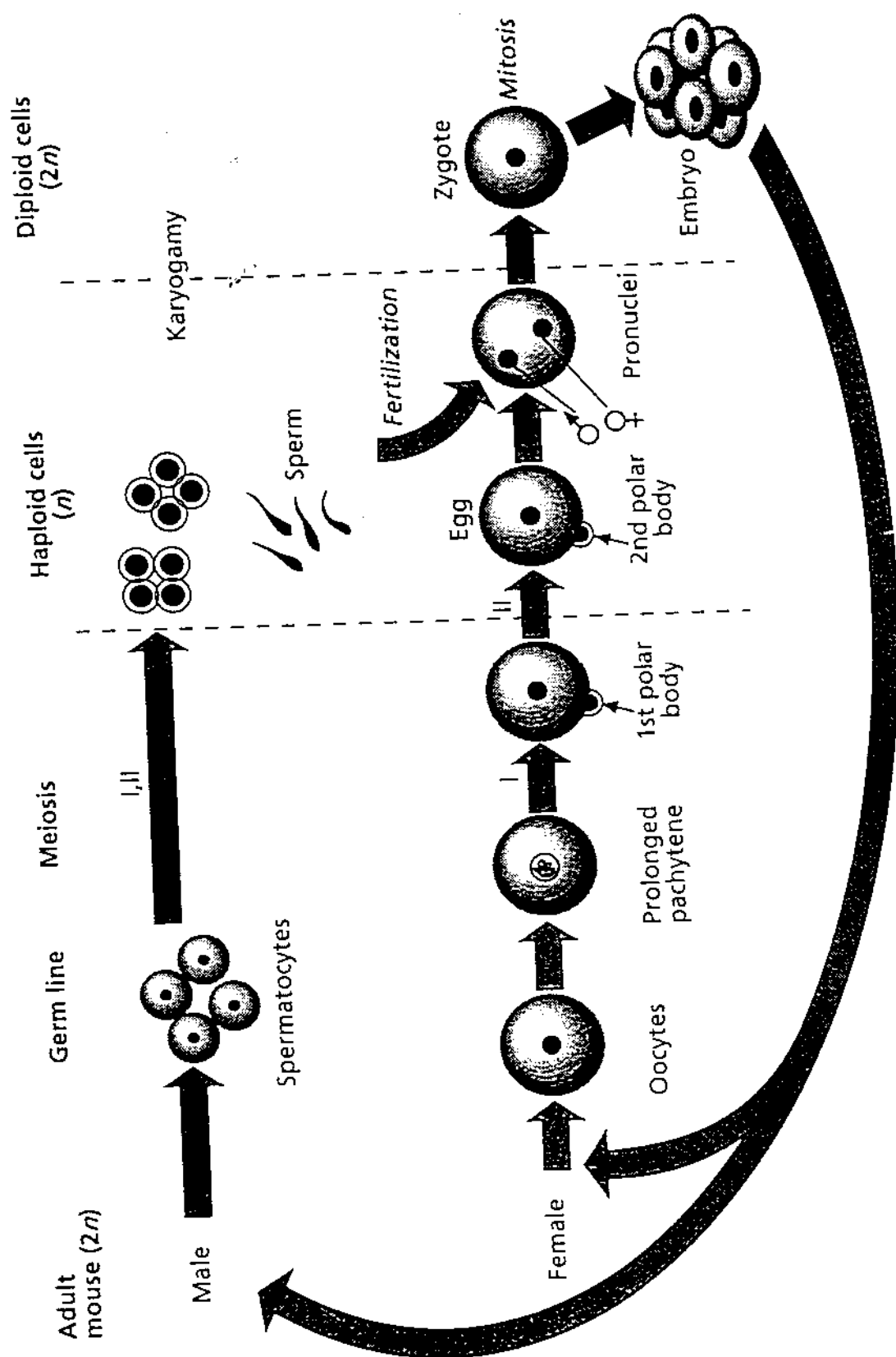


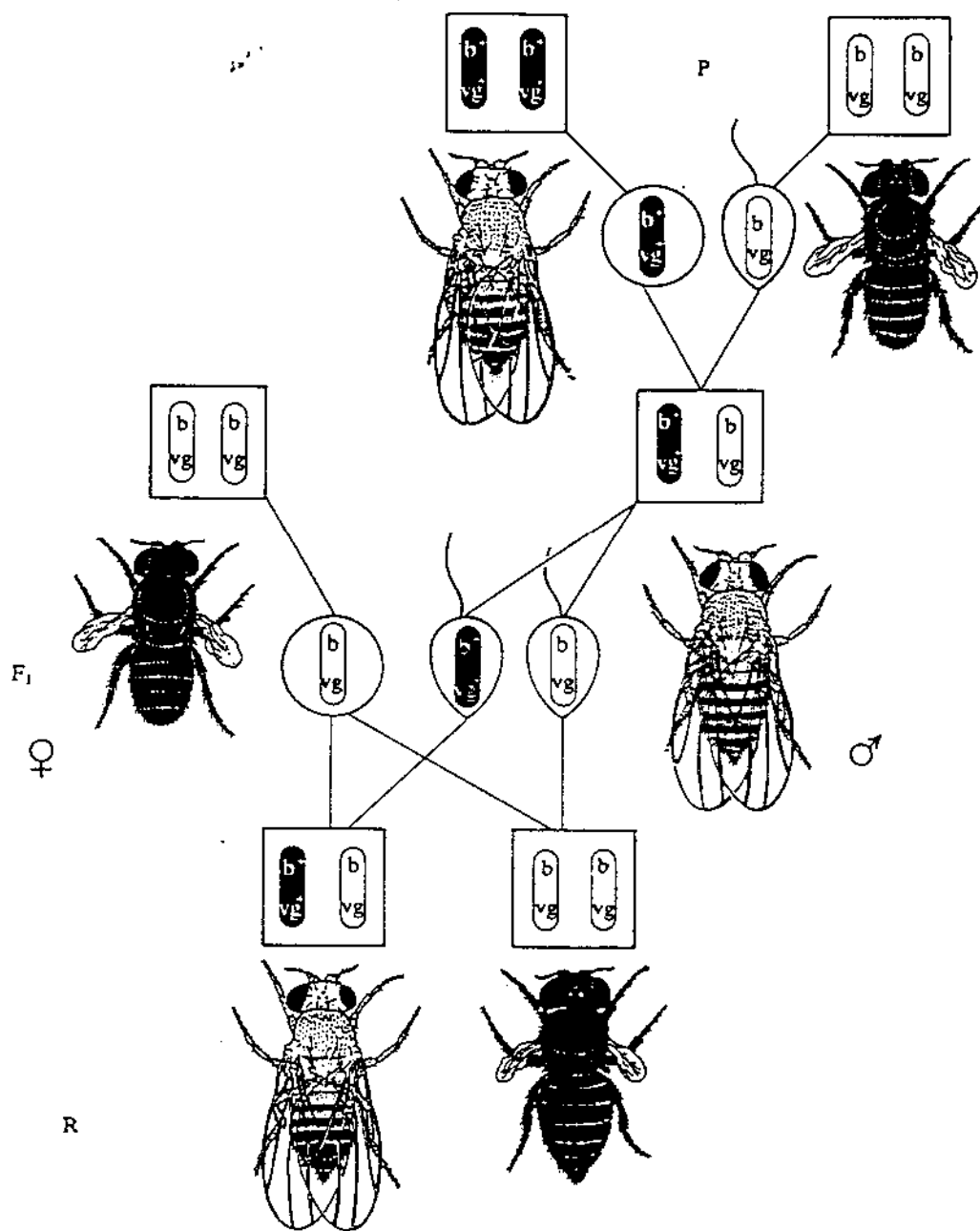
meiotische Prophase I

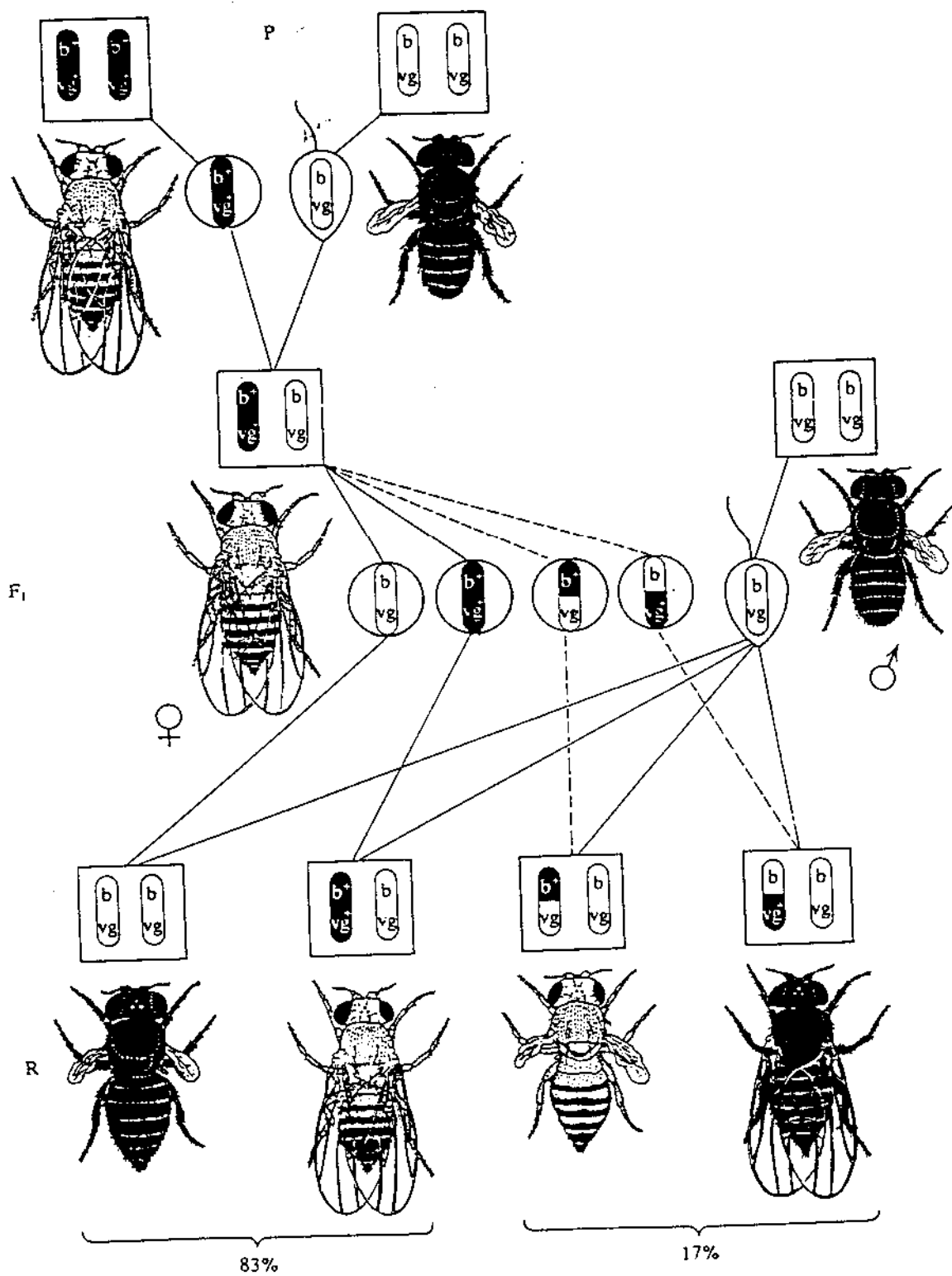


sekundäre Meiozyten







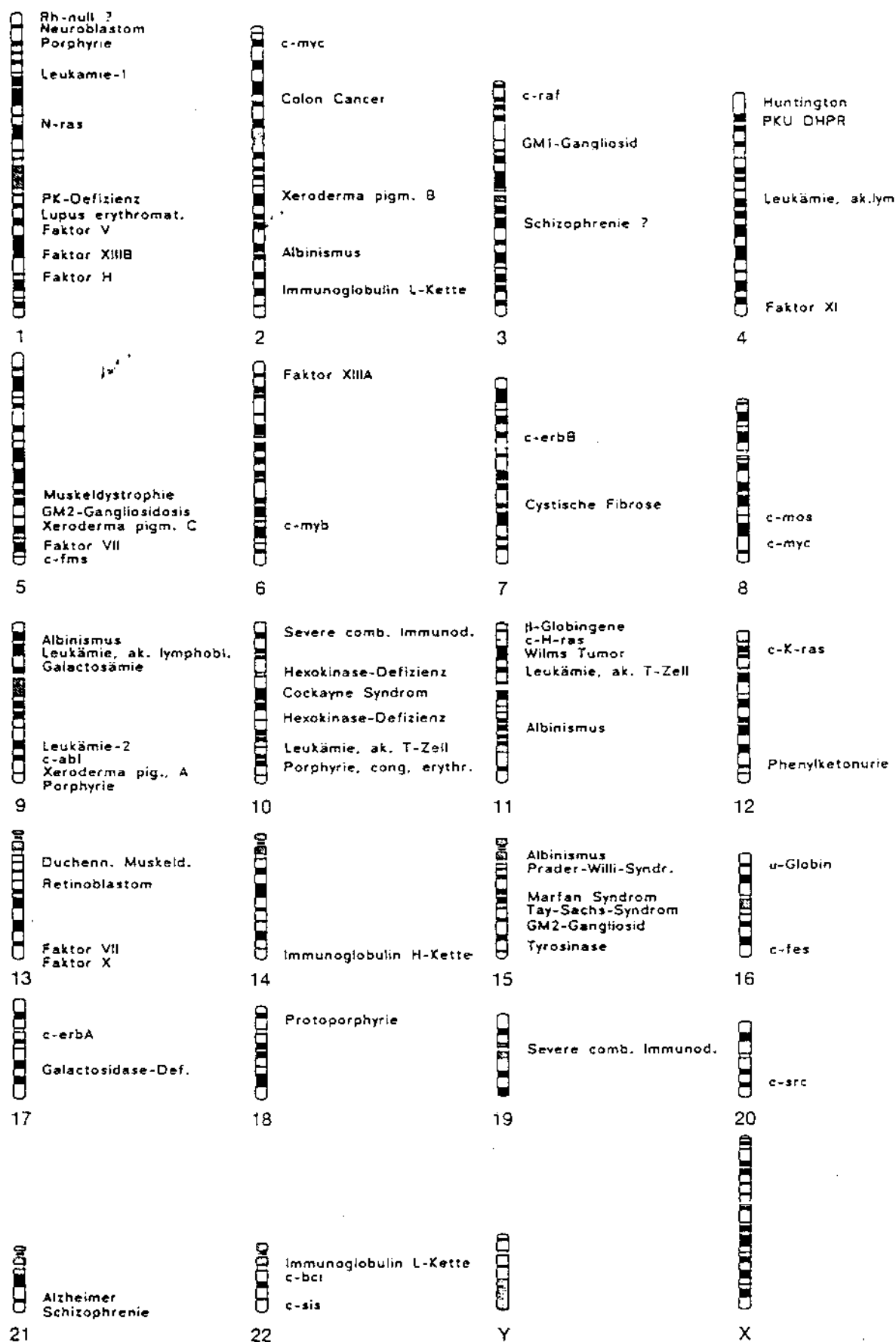


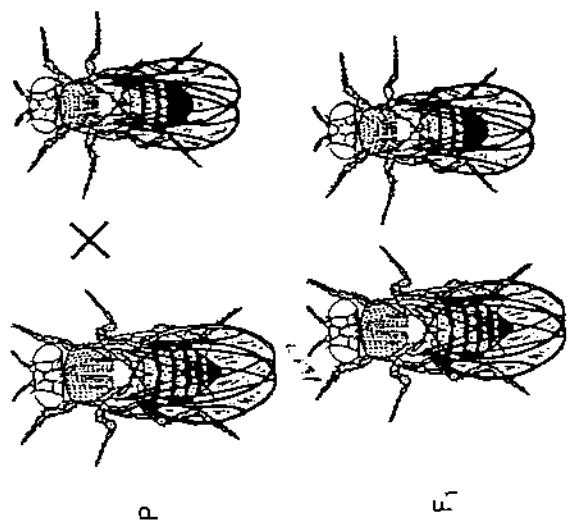
Mutter	w^+	m^+	fw
	w	m	fw^+

Nach Rückkreuzung gefundene Gametentypen	1. $+$	$+$	fw	142 = 68,27% Parentaltypen ohne Aus- tausch
	2. w	m	$+$	
	3. $+$	m	$+$	59 = 28,37% Rekombinantenklasse I: (einfacher) Austausch von w
	4. w	$+$	fw	
	5. $+$	$+$	$+$	4 = 1,92% Rekombinantenklasse II: (einfacher) Austausch von fw
	6. w	m	fw	
	7. w	$+$	$+$	3 = 1,44% Rekombinantenklasse III: doppelter Austausch
	8. $+$	m	fw	

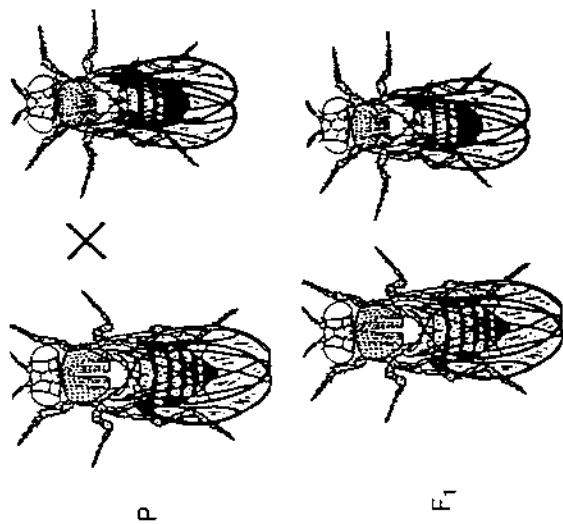
Daraus Austauschhäufigkeiten:

w/m (Typen 3 + 4 + 7 + 8)	= 29,81%
m/fw (Typen 5 + 6 + 7 + 8)	= 3,36%
w/fw (durch Addition)	= 33,17%
w/fw (unmittelbar 3 + 4 + 5 + 6)	= 30,29%
Differenz	2,88%





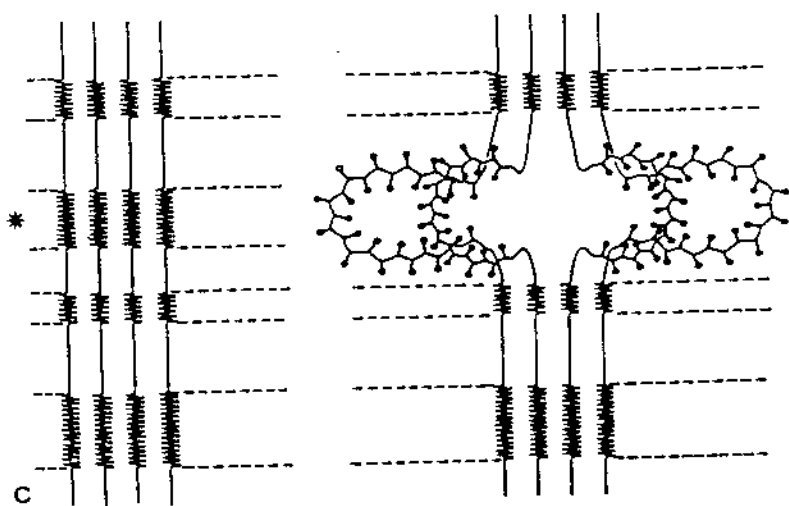
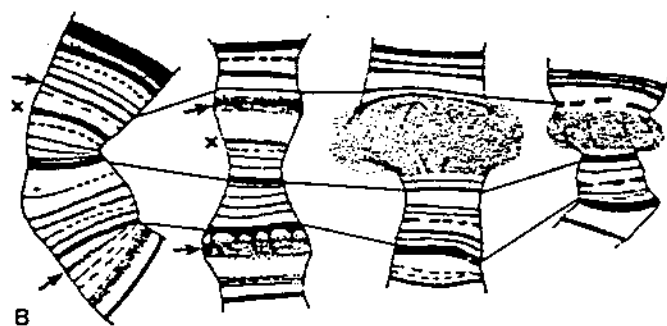
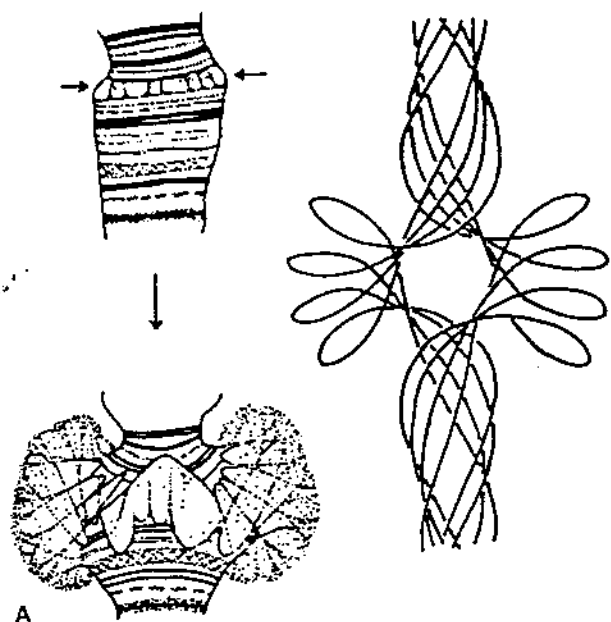
	w	Y
w ⁺	w ⁺ w	w ⁺ Y
w ⁺	w ⁺ w	w ⁺ Y



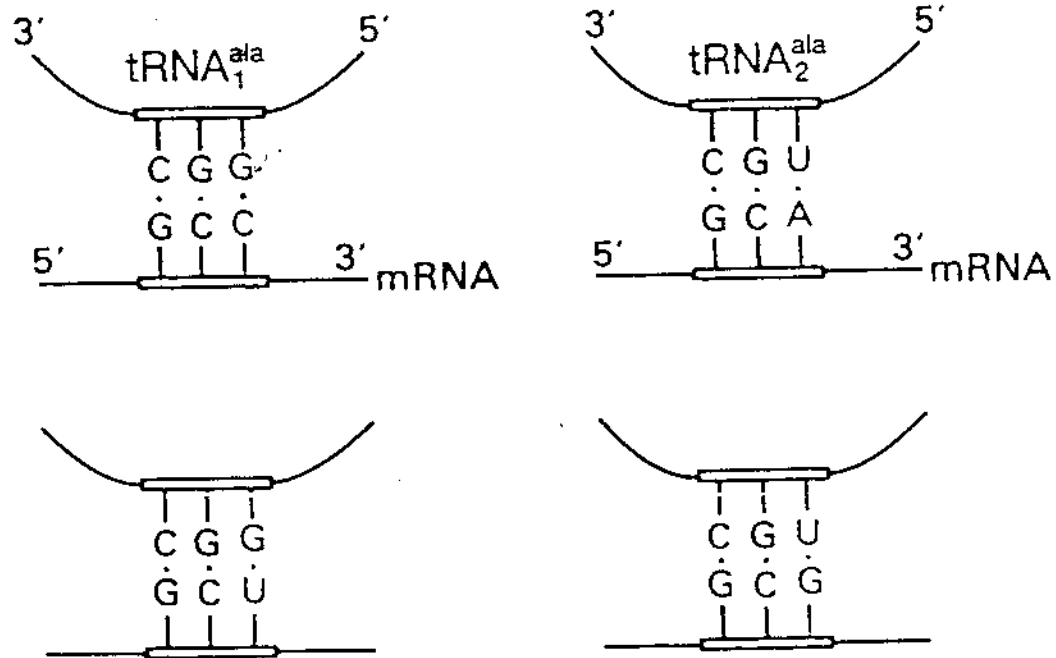
	w ⁺	Y
w	ww ⁺	wY
w	ww ⁺	wY

B

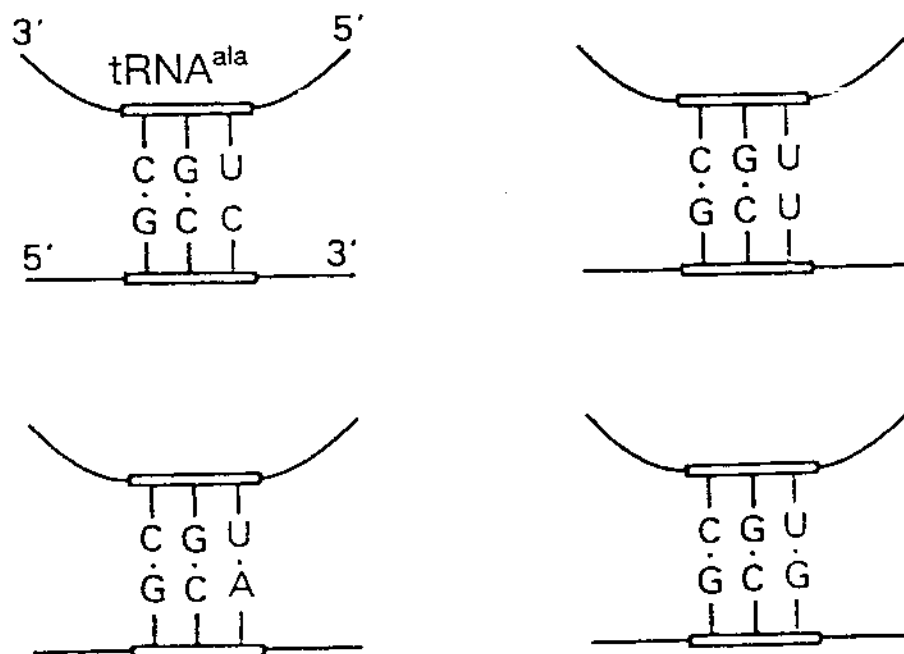
A

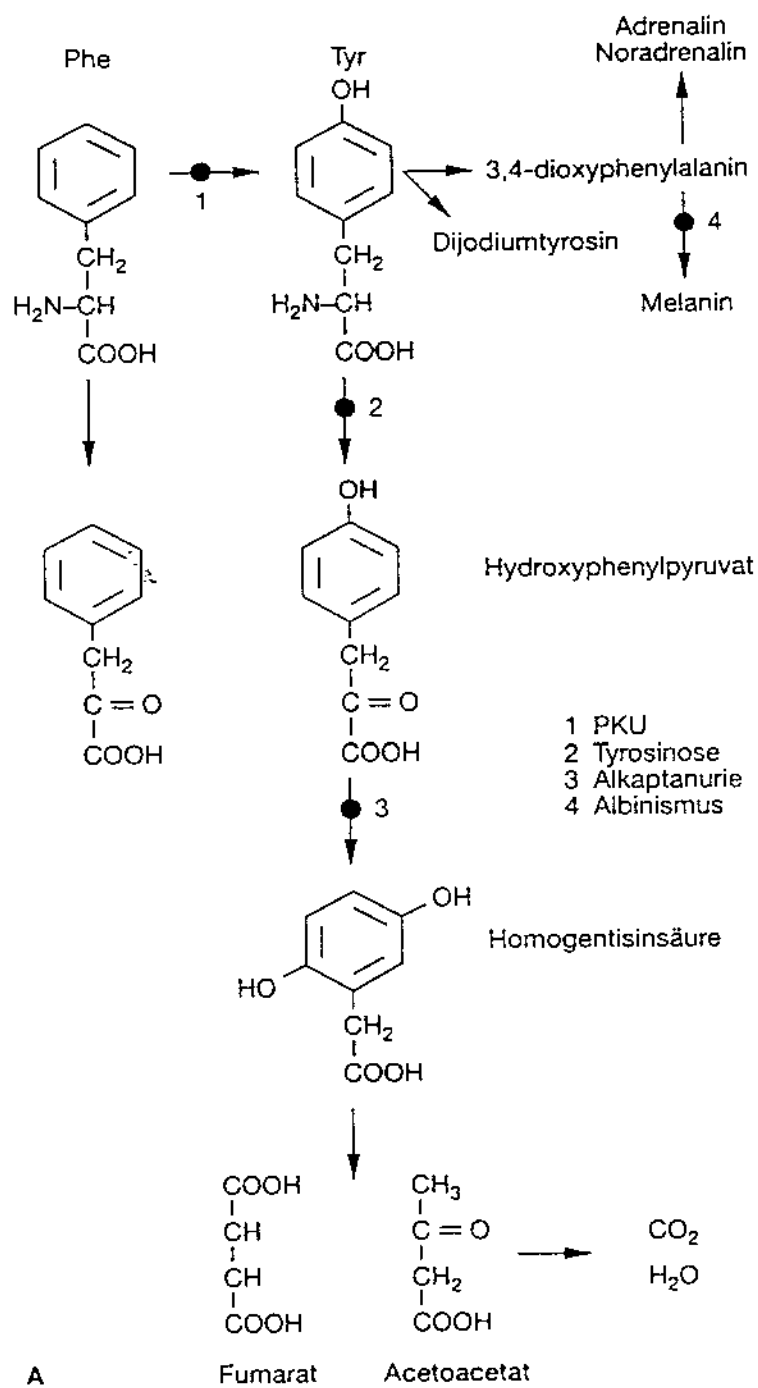


a) Standard-„Wobble“-Regeln

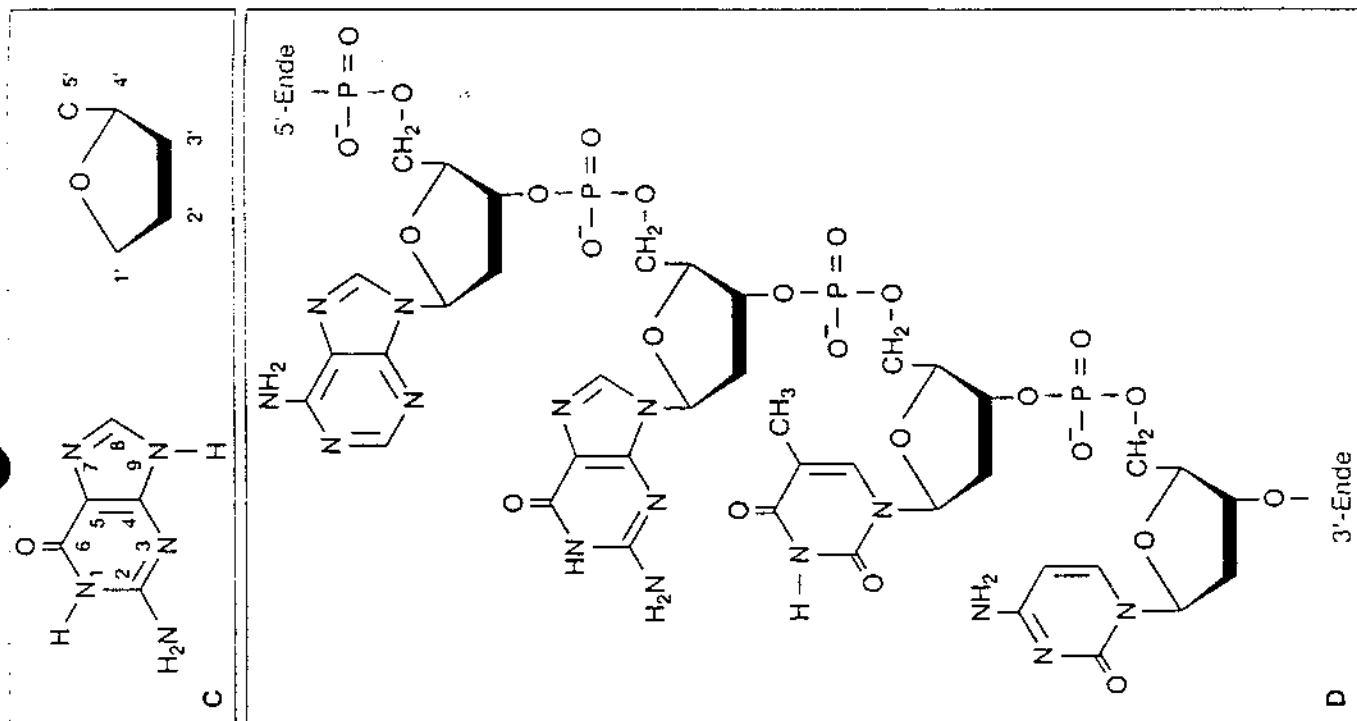
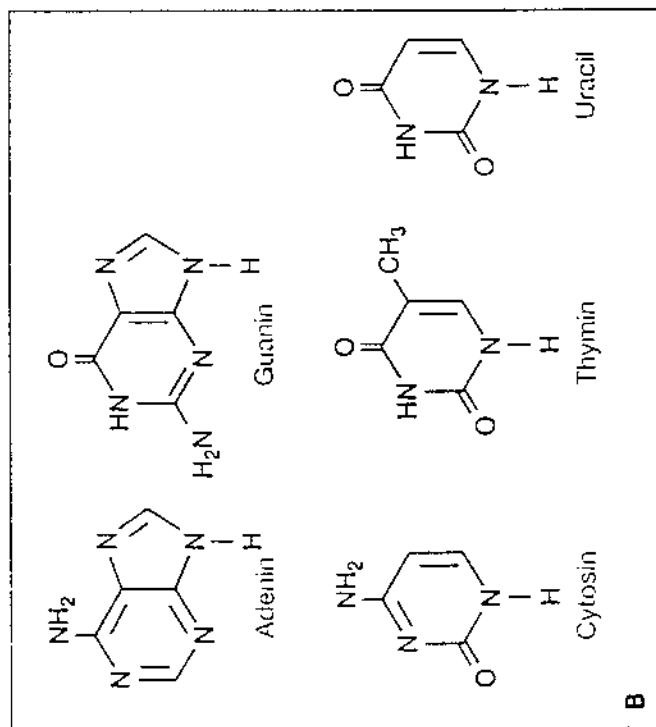
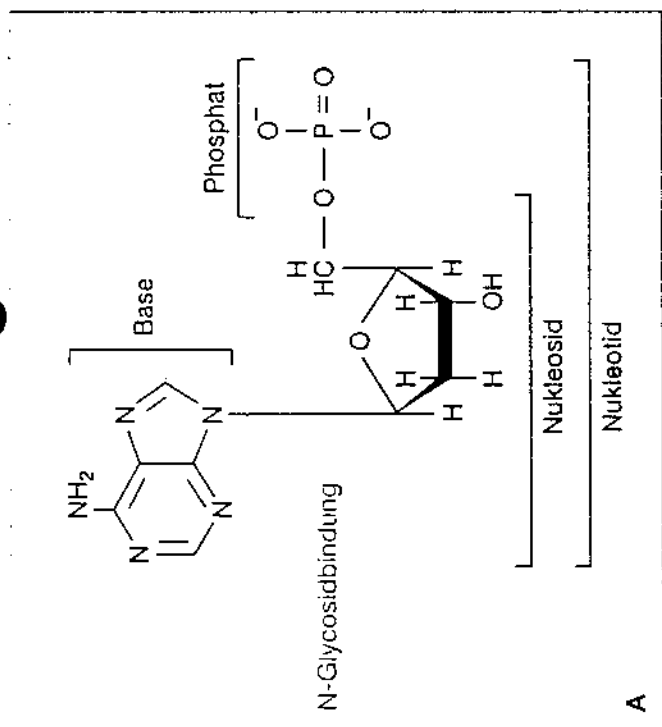


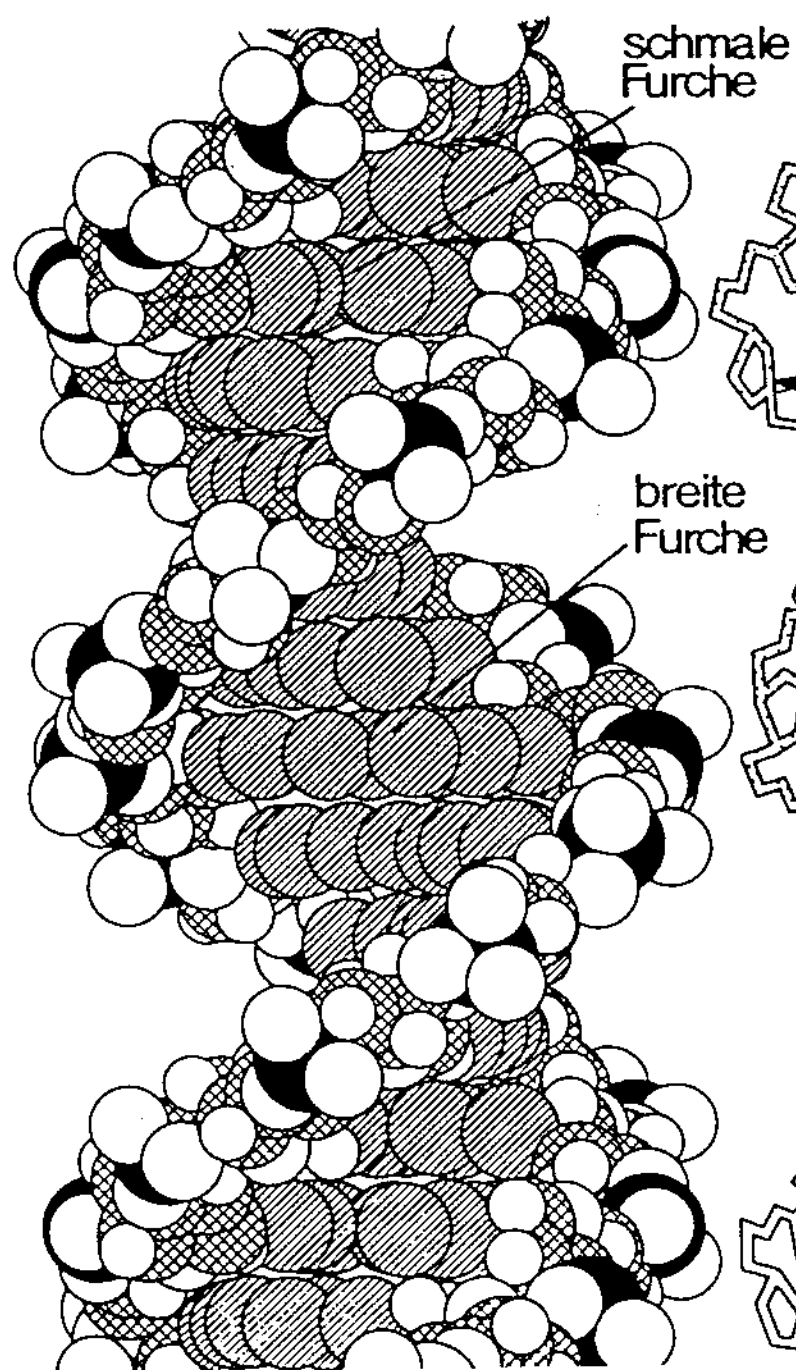
b) „Superwobble“ in menschlichen Mitochondrien



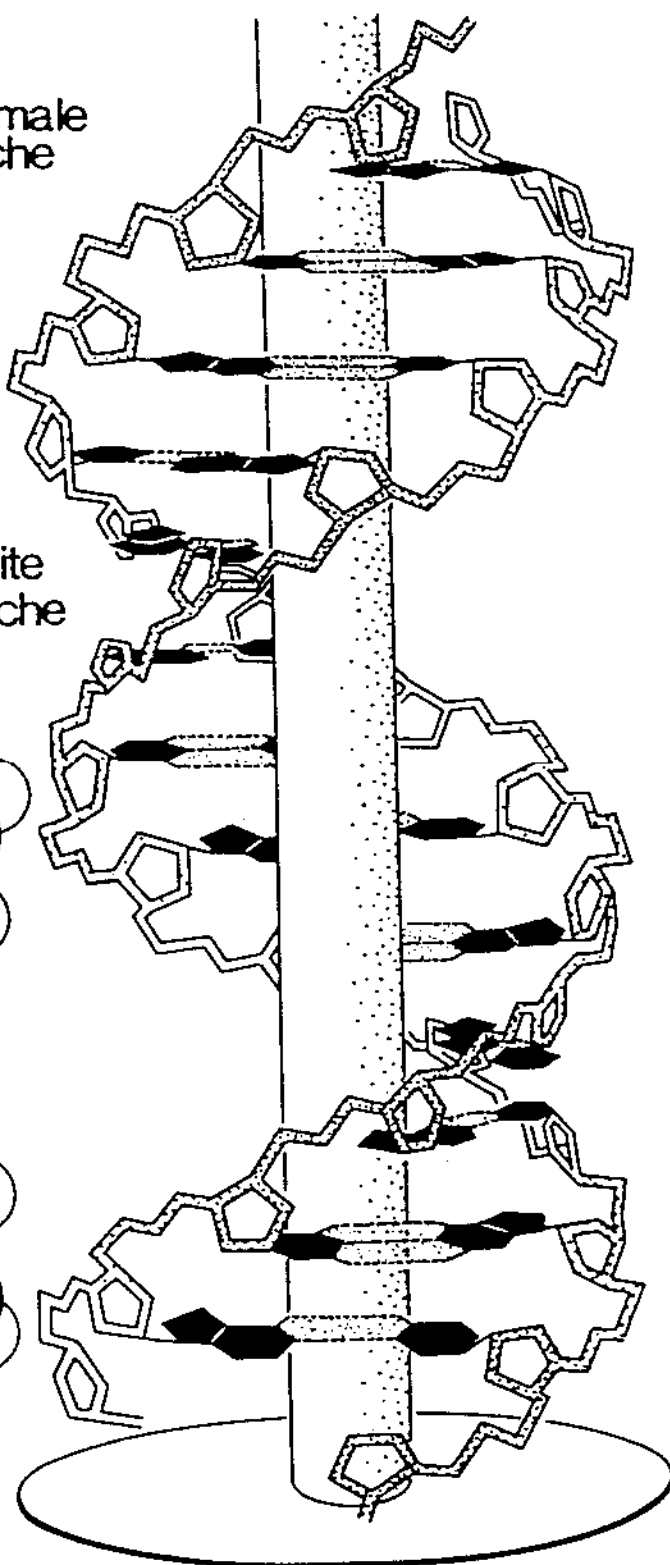


A

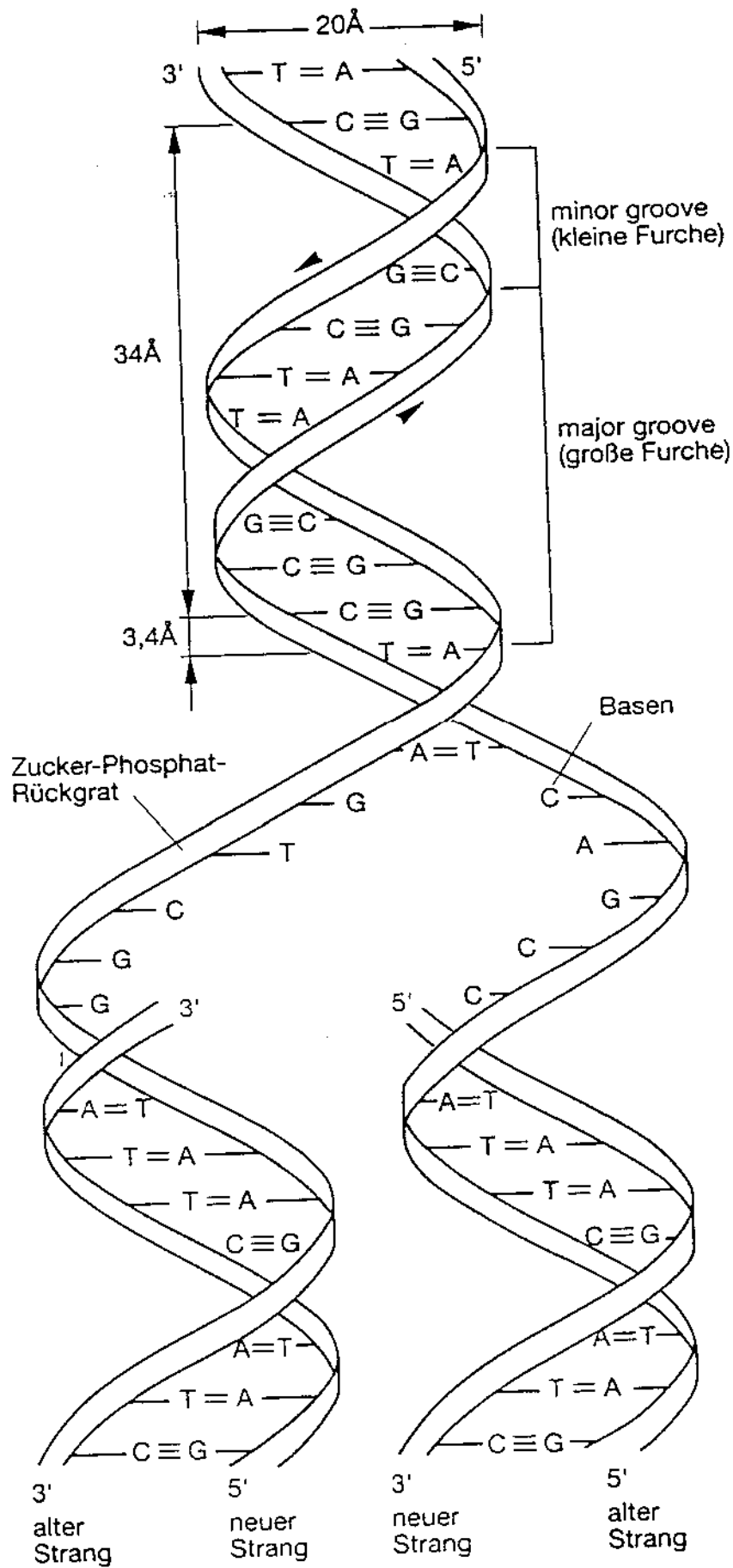


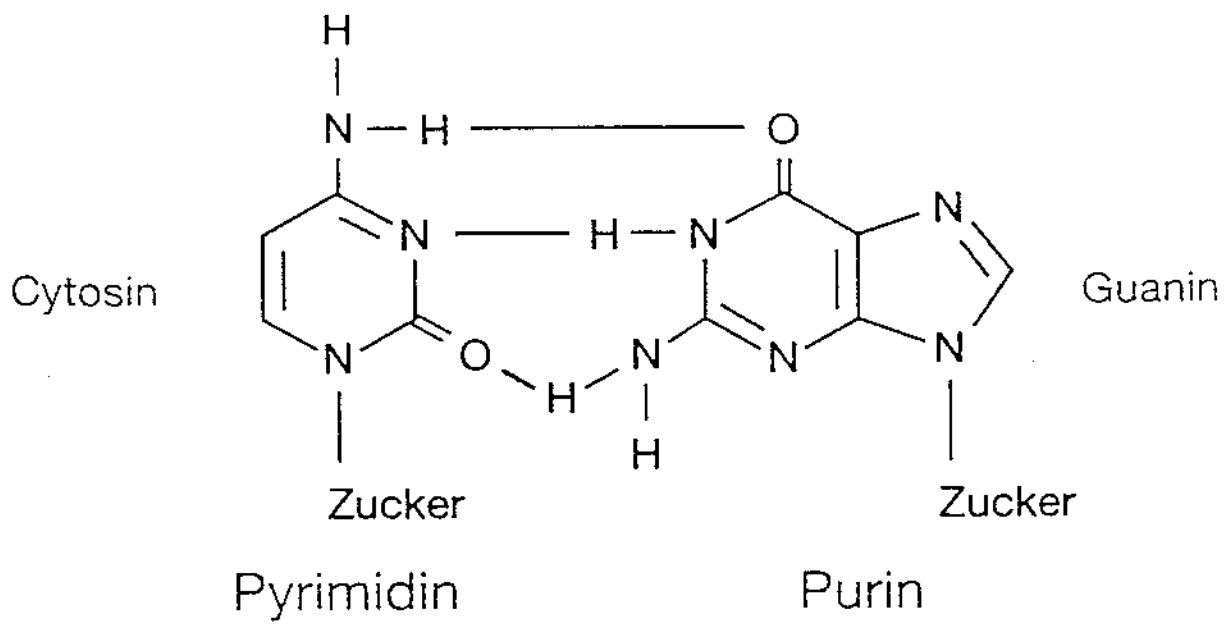
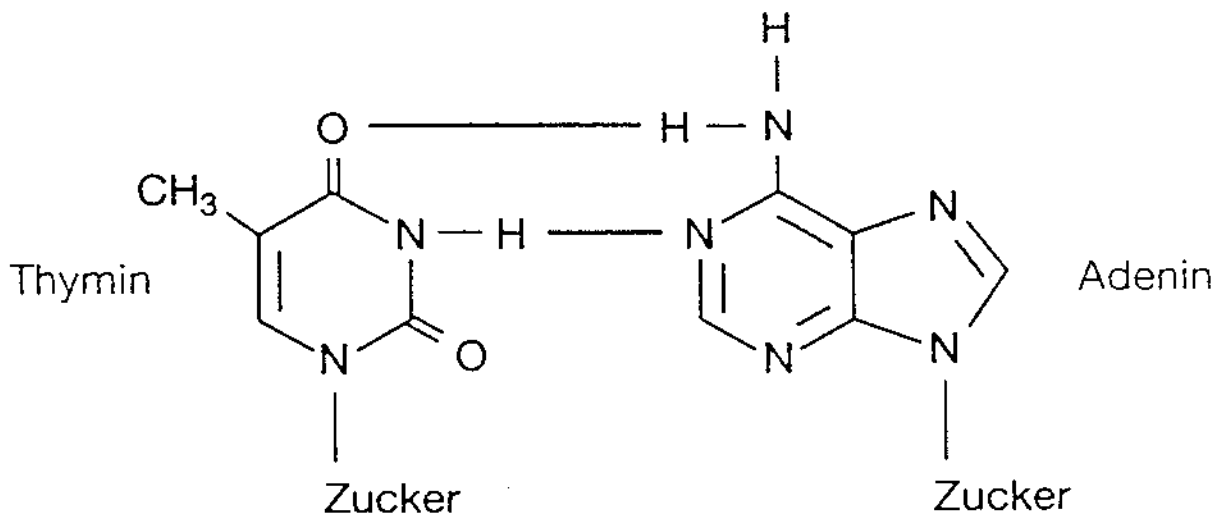


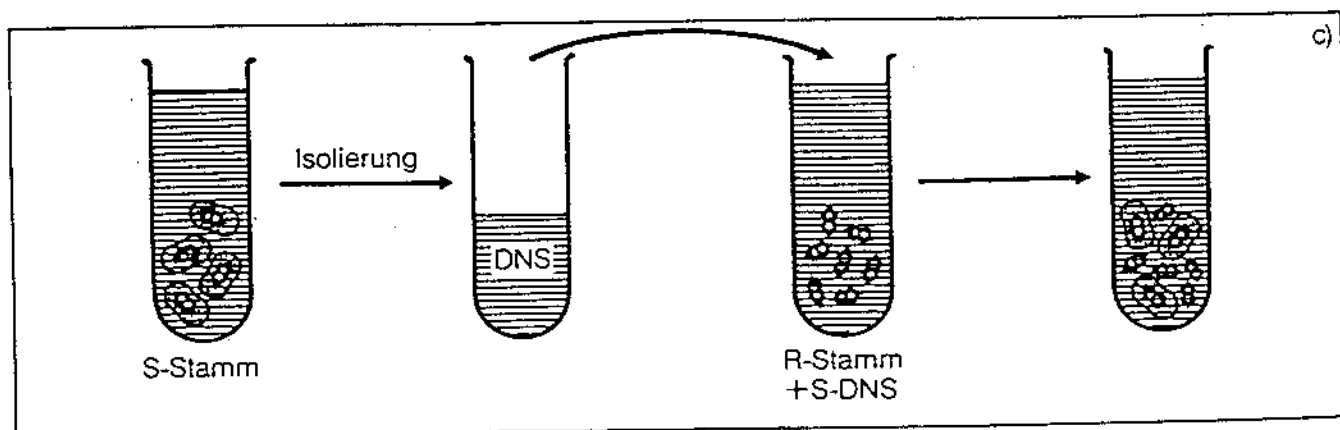
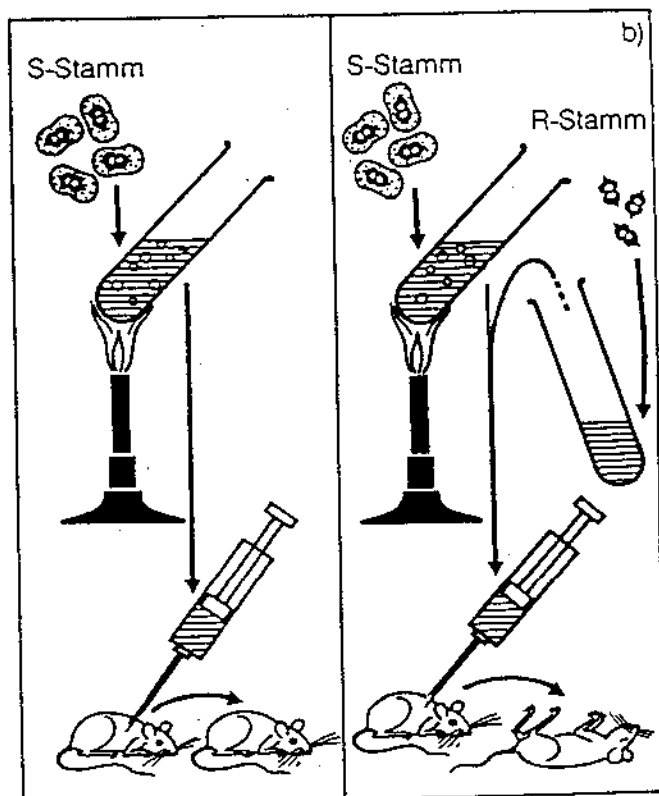
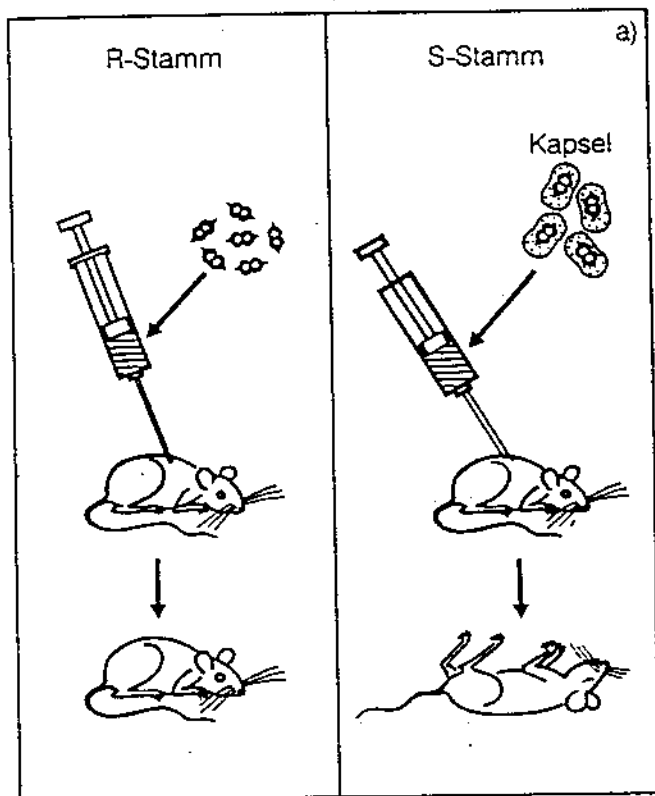
a



b







Zufügen von ^{32}P - und ^{35}S -markierten
Bakteriophagen

E. coli-
Kultur

Bakteriophage

Bakterium

Schütteln oder Rühren
der Kultur nach
einigen Minuten

Phagenpartikel

Bakteriophagengene

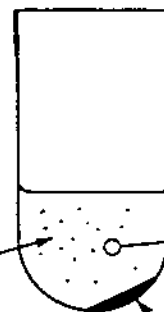
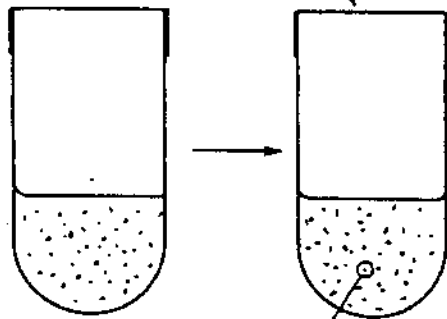
Zentrifugation

^{35}S

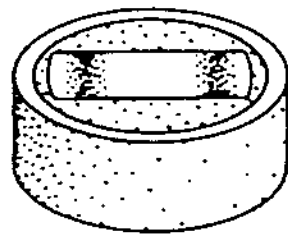
^{32}P

Phagenpartikel in
der Suspension

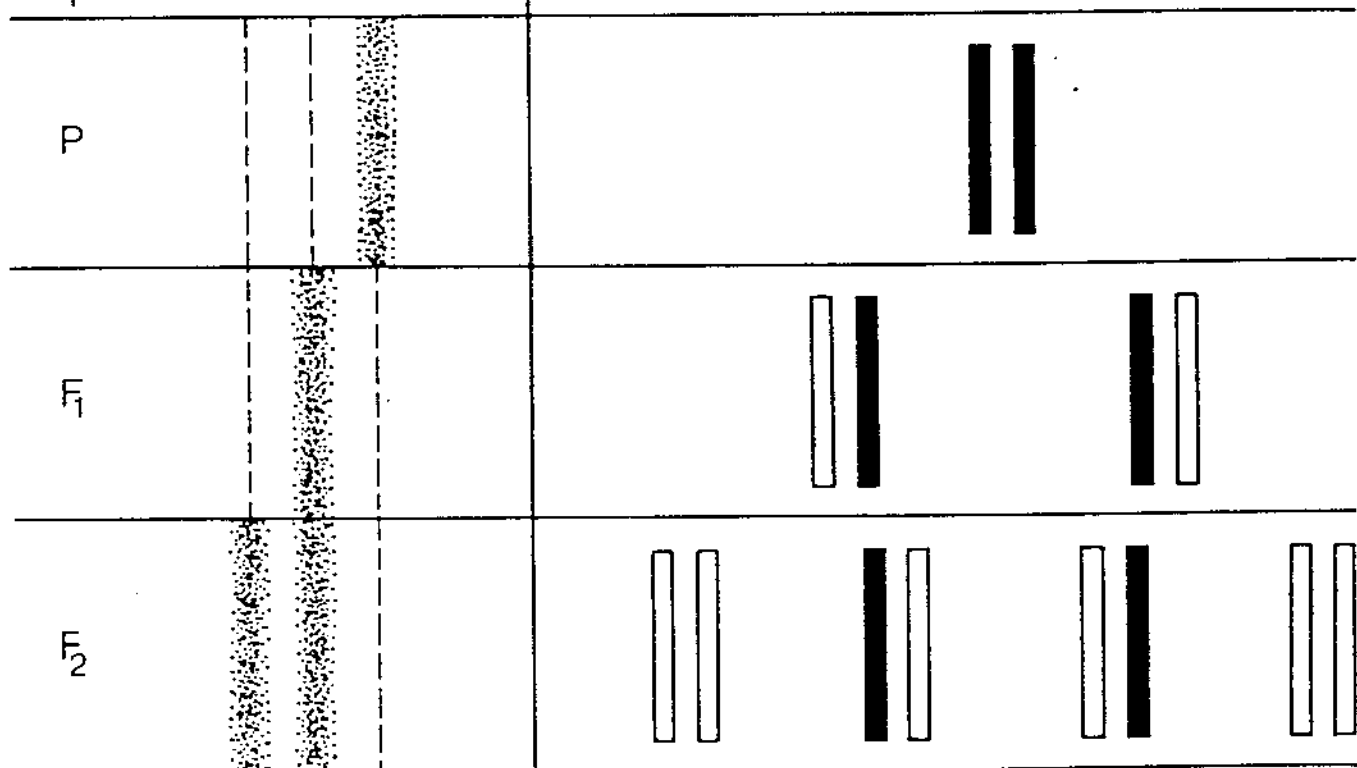
Bakterien und Phagengene
am Boden des Röhrchens



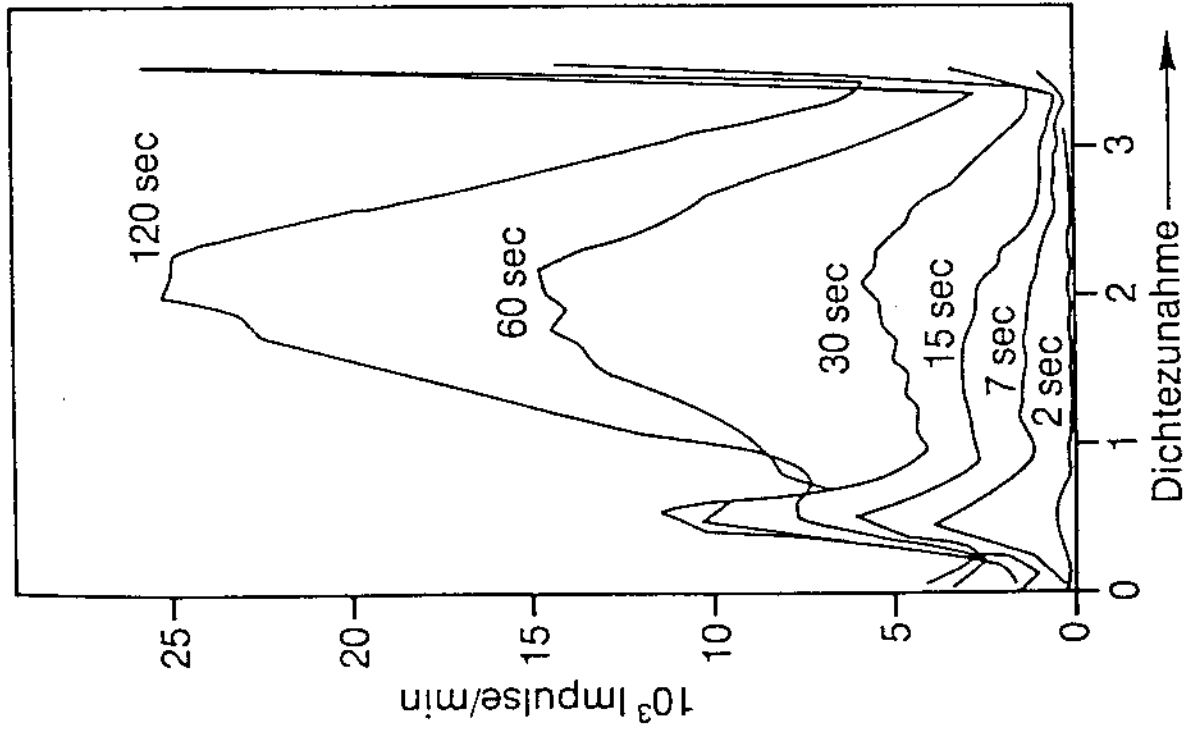
^{14}N - ^{15}N - DNA



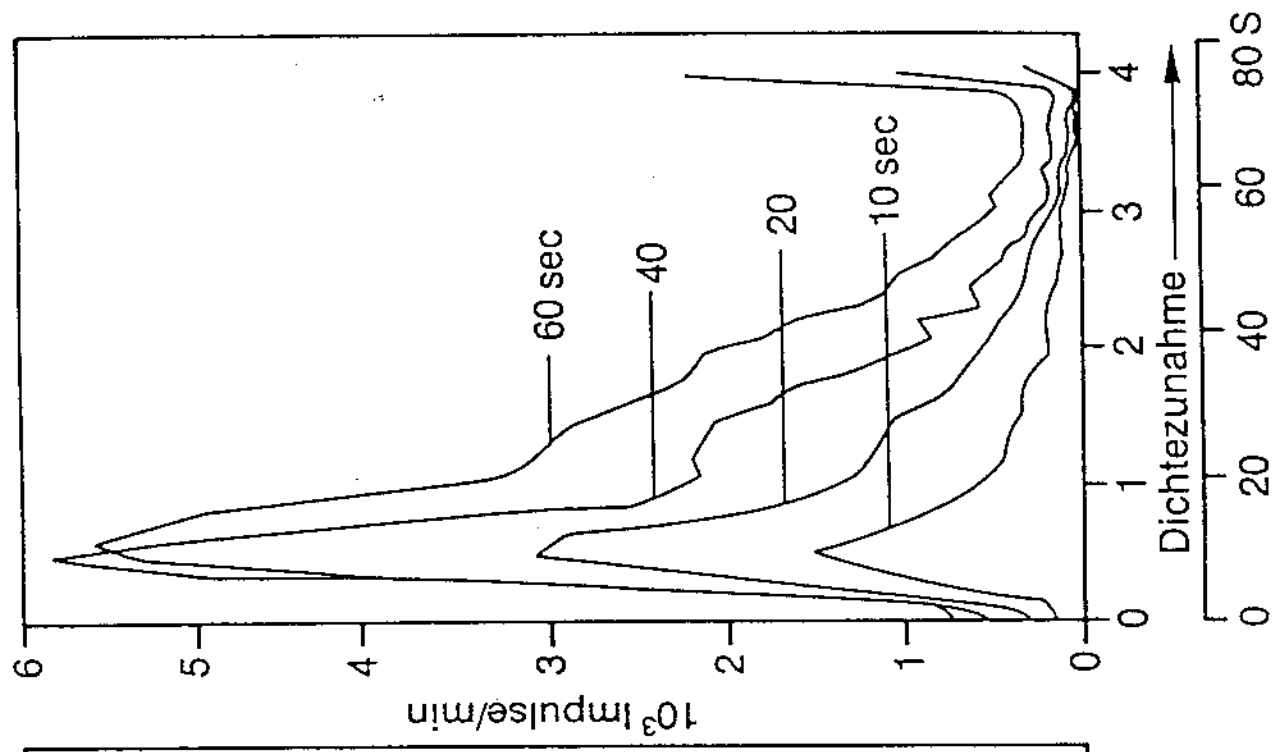
Mischung aus ^{14}N - und ^{15}N - DNA



a



b



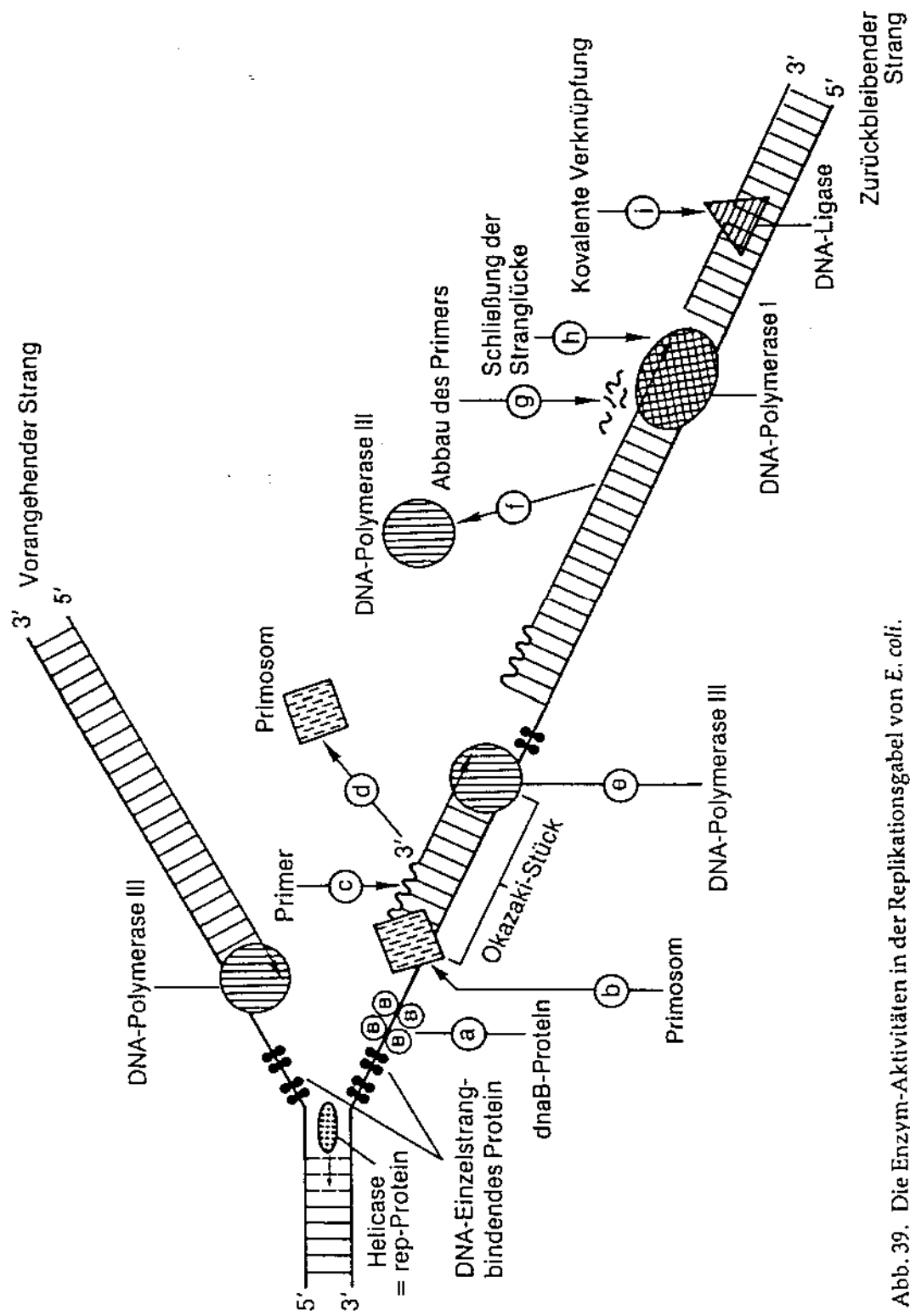
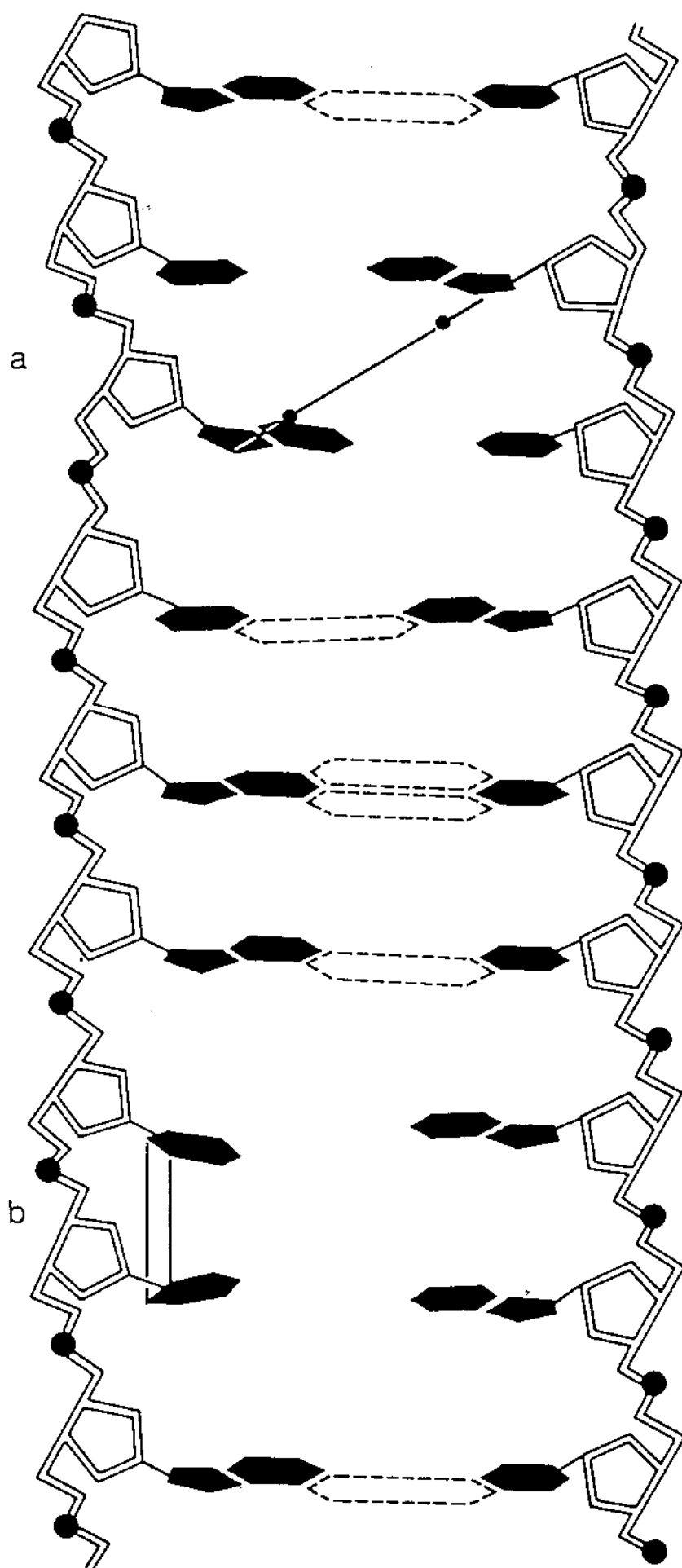
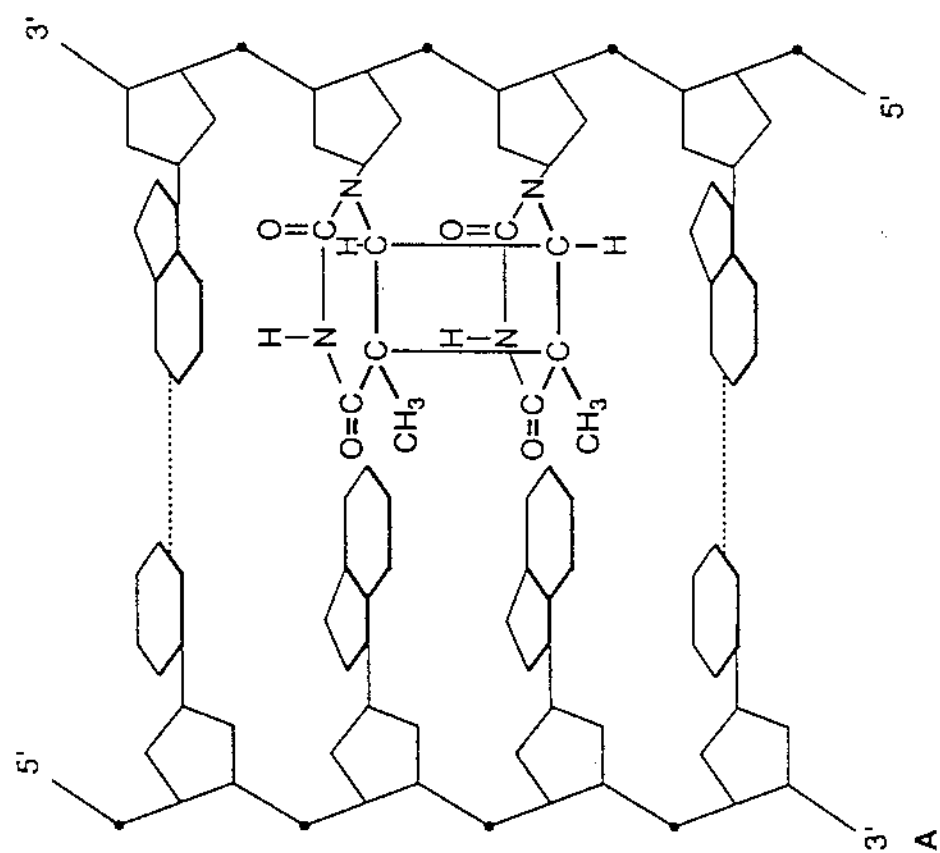
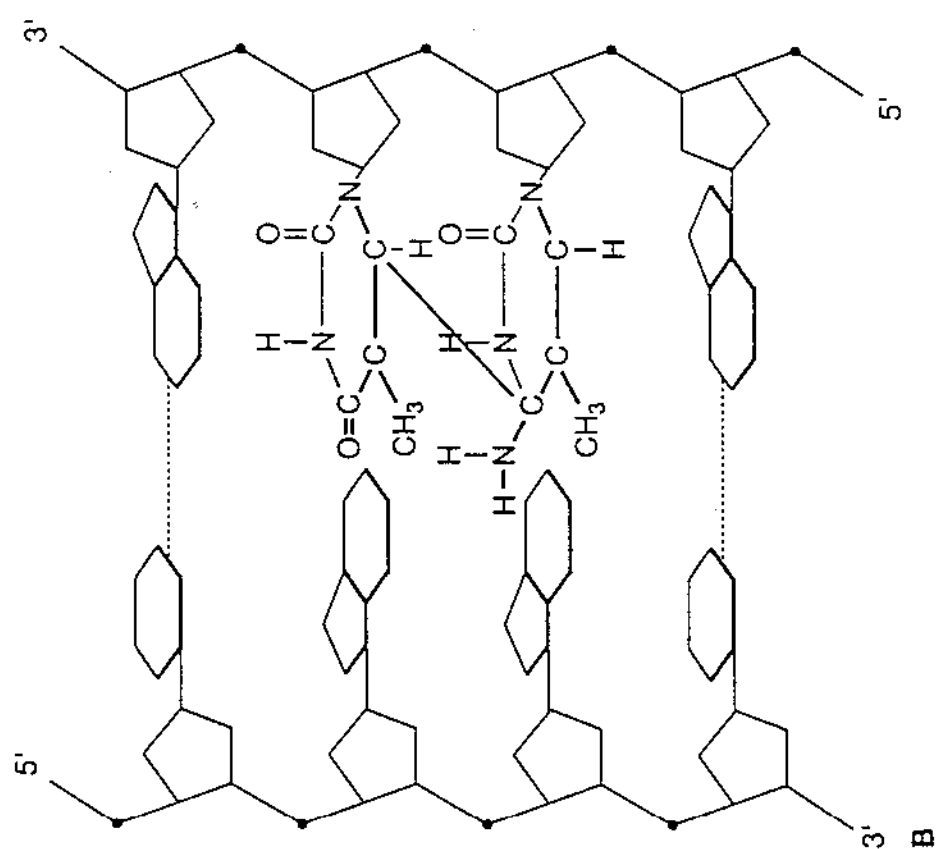
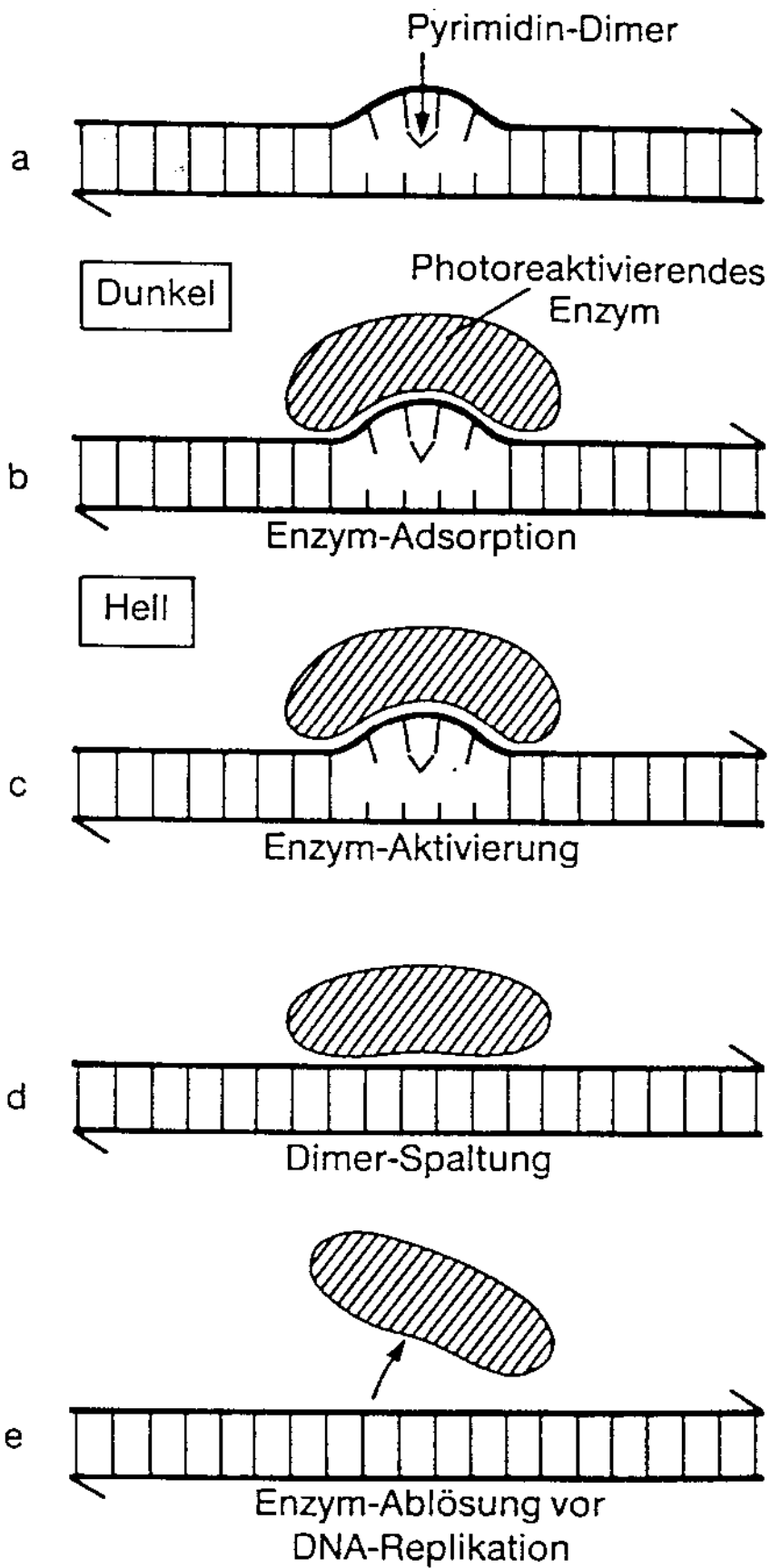
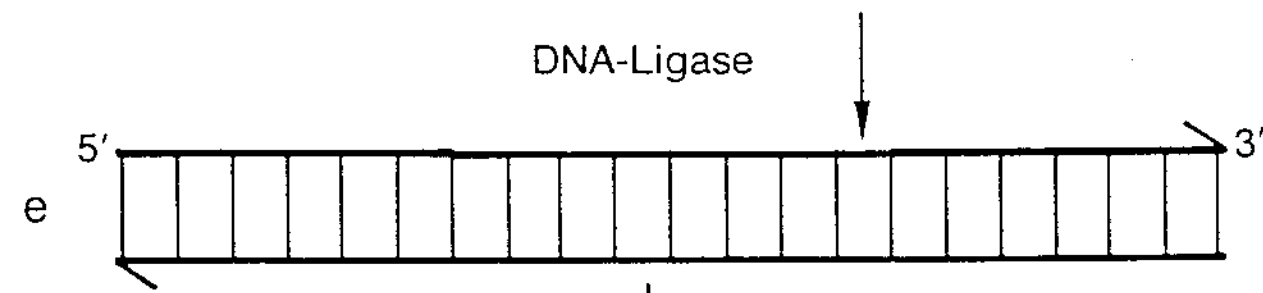
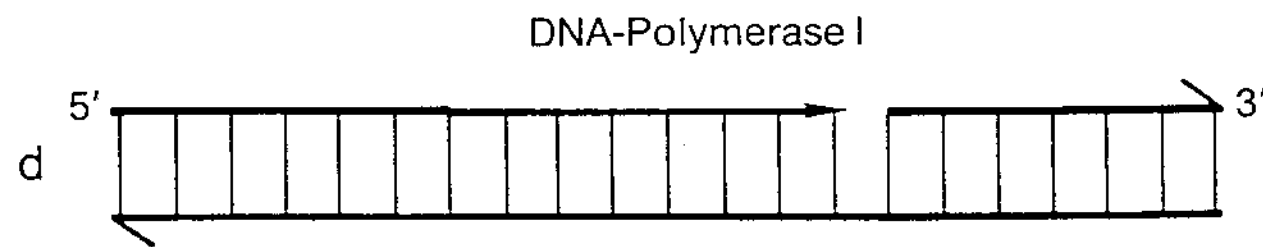
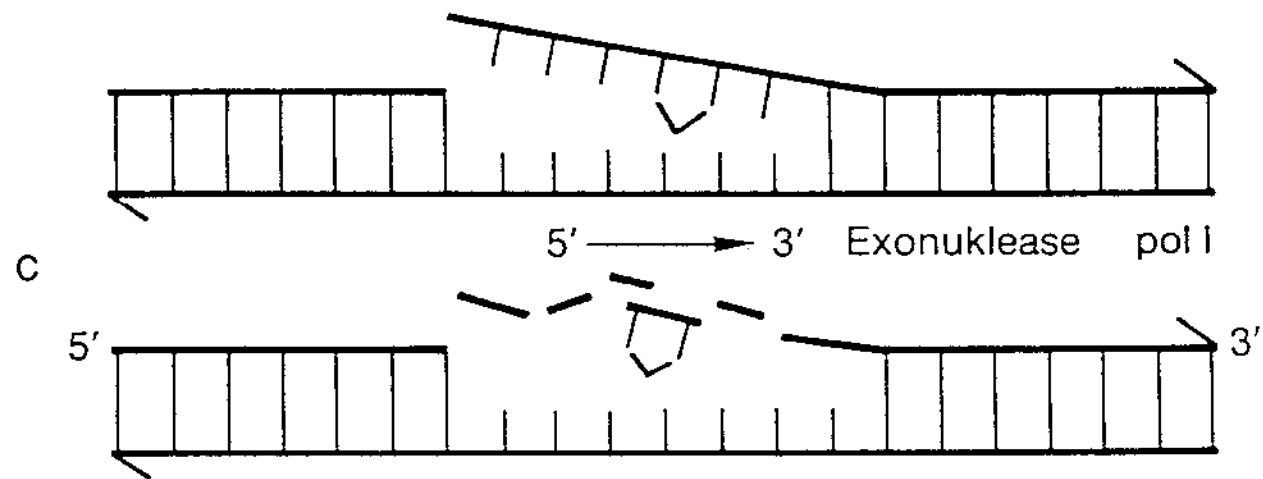
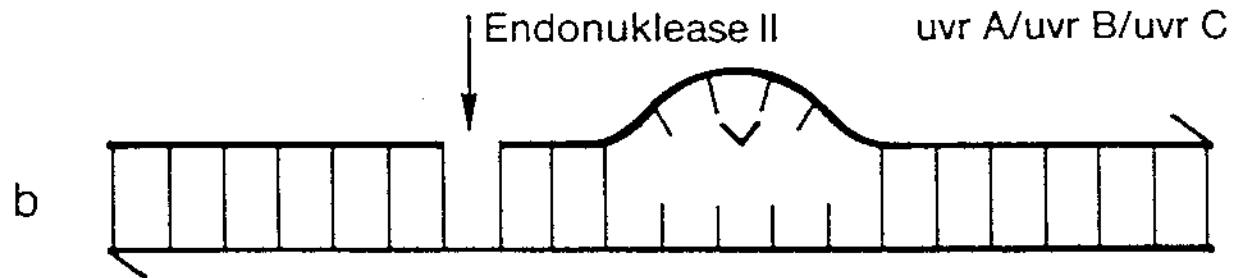
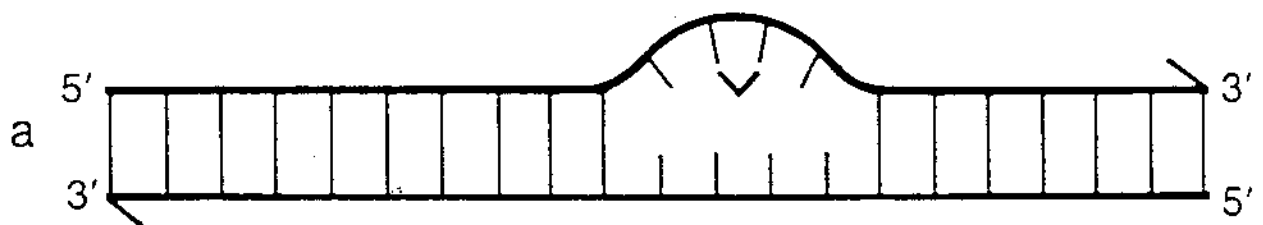


Abb. 39. Die Enzym-Aktivitäten in der Replikationsgabel von *E. coli*.

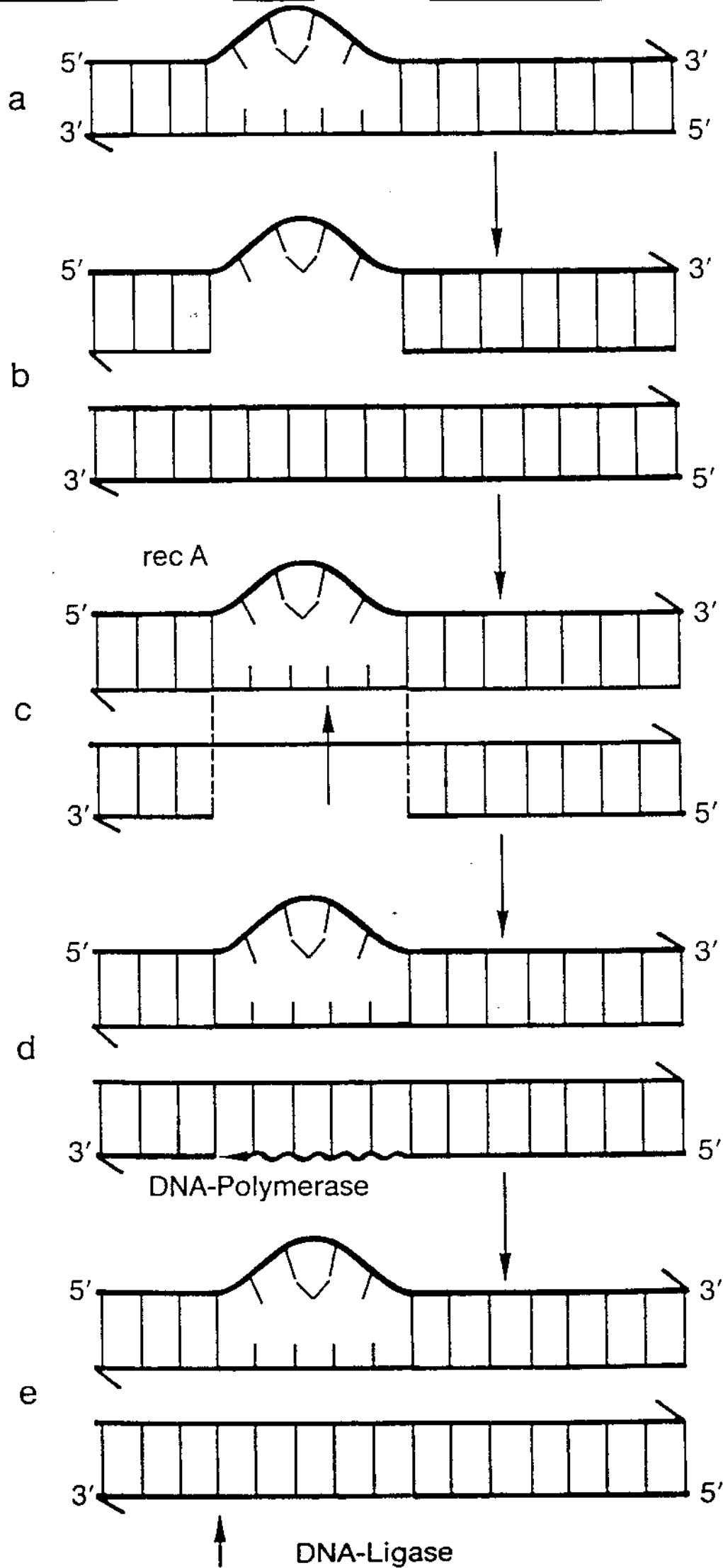


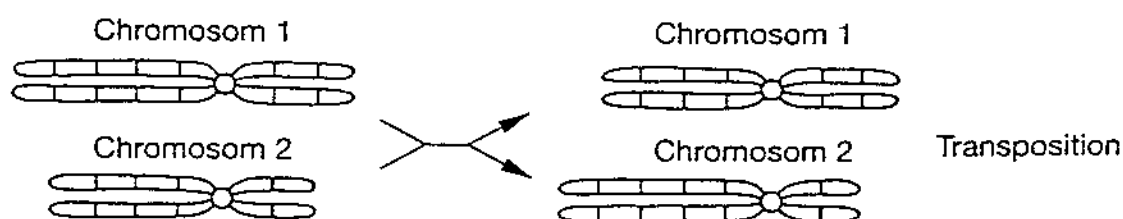
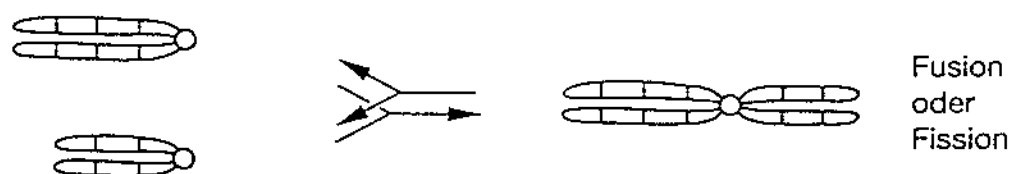
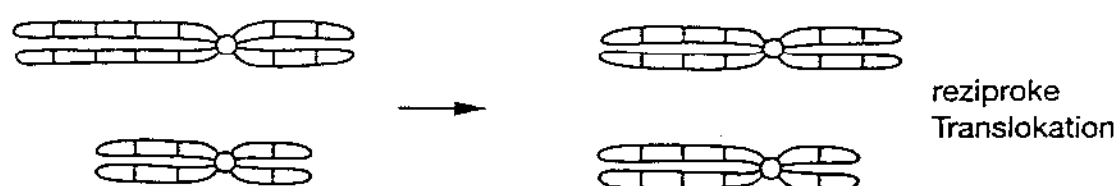
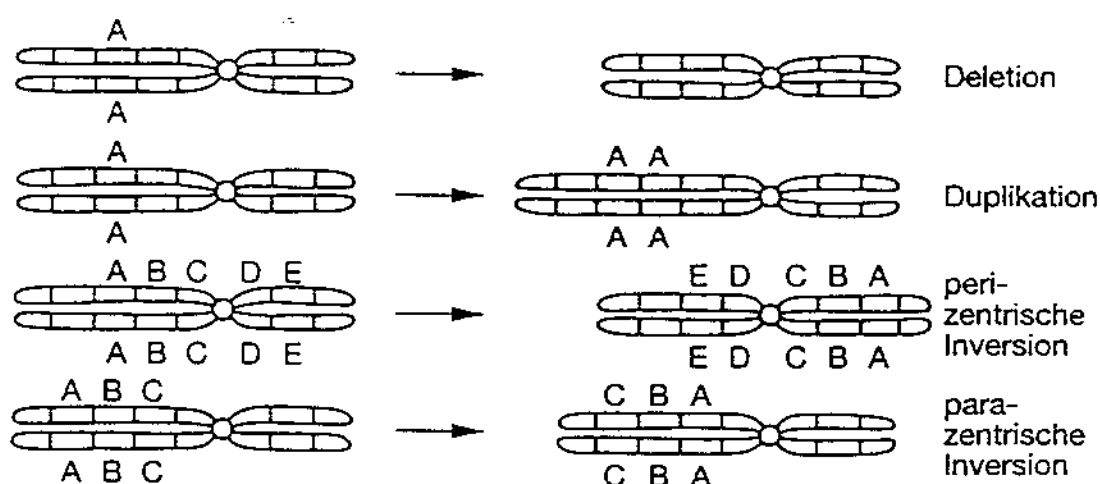


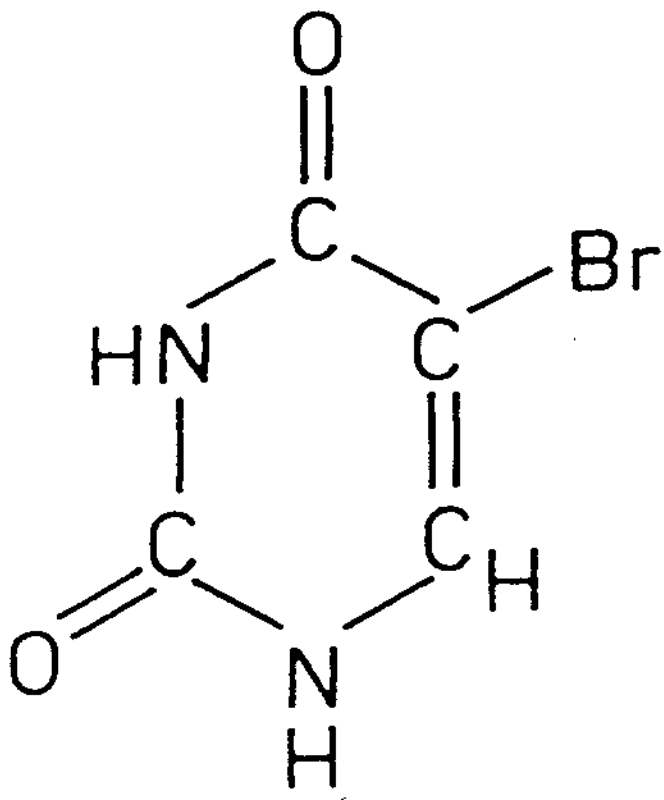




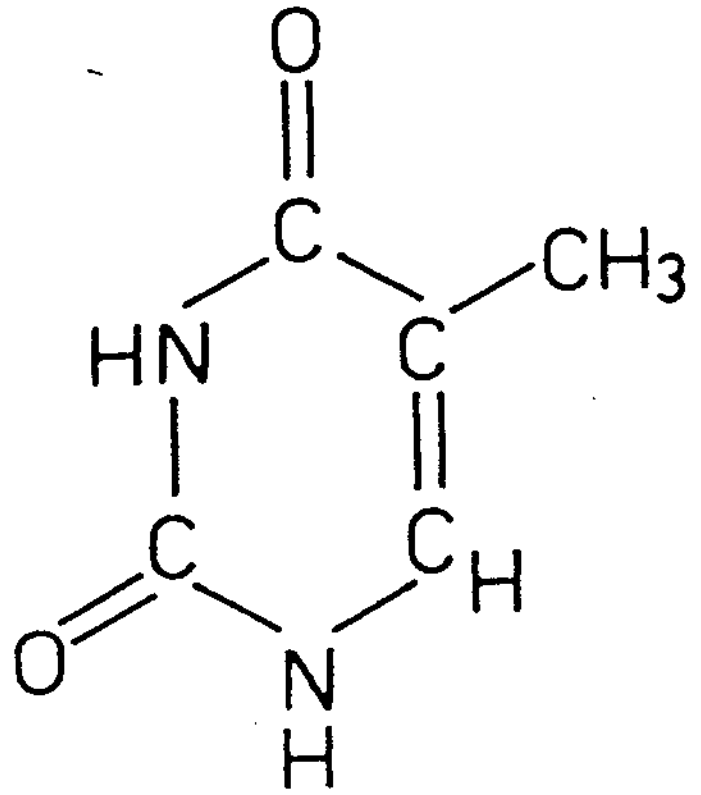
DNA-Replikation



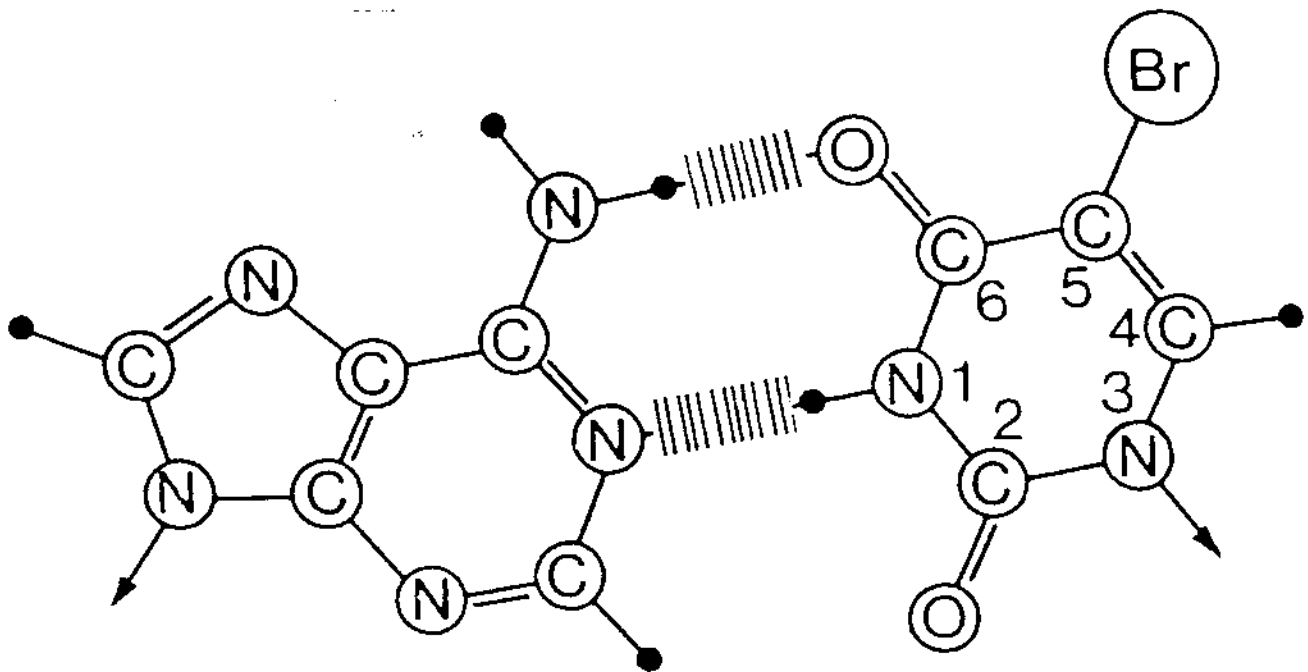




5'-Bromuracil

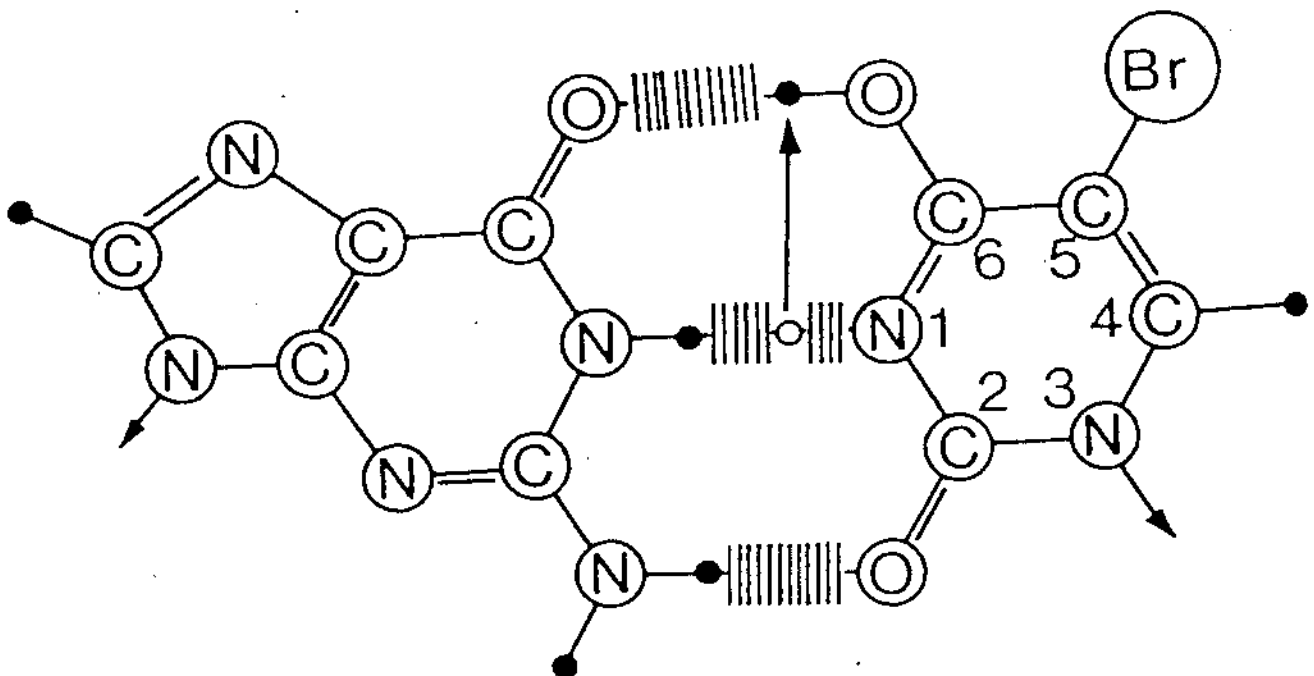


Thymin



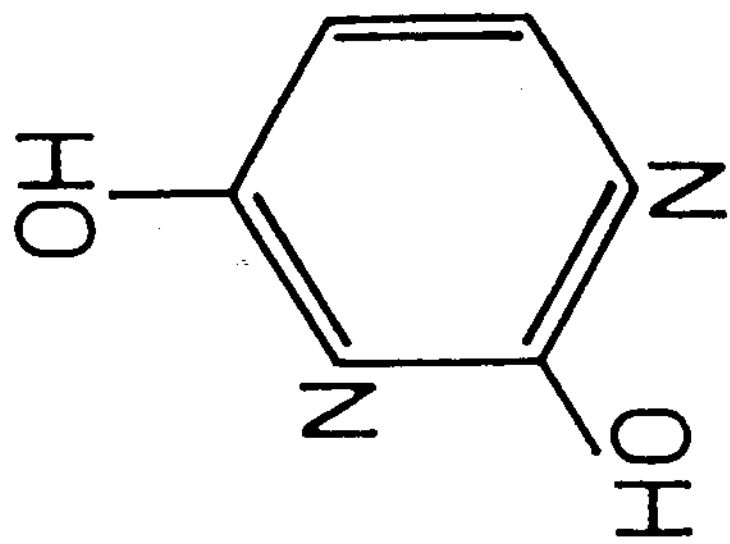
Adenin

5' – Bromuracil
(normaler Ketozustand)

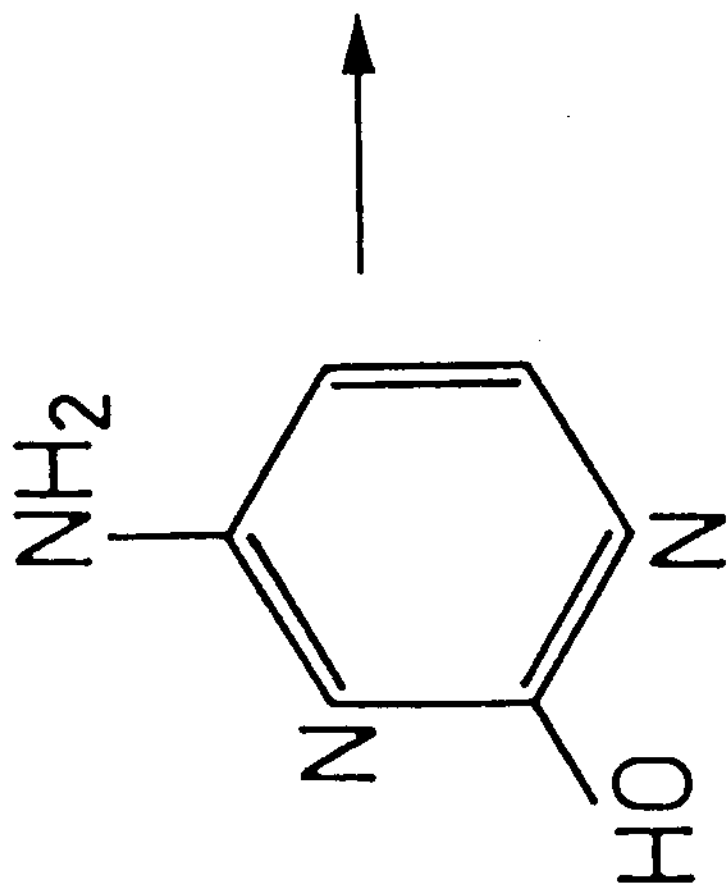


Guanin

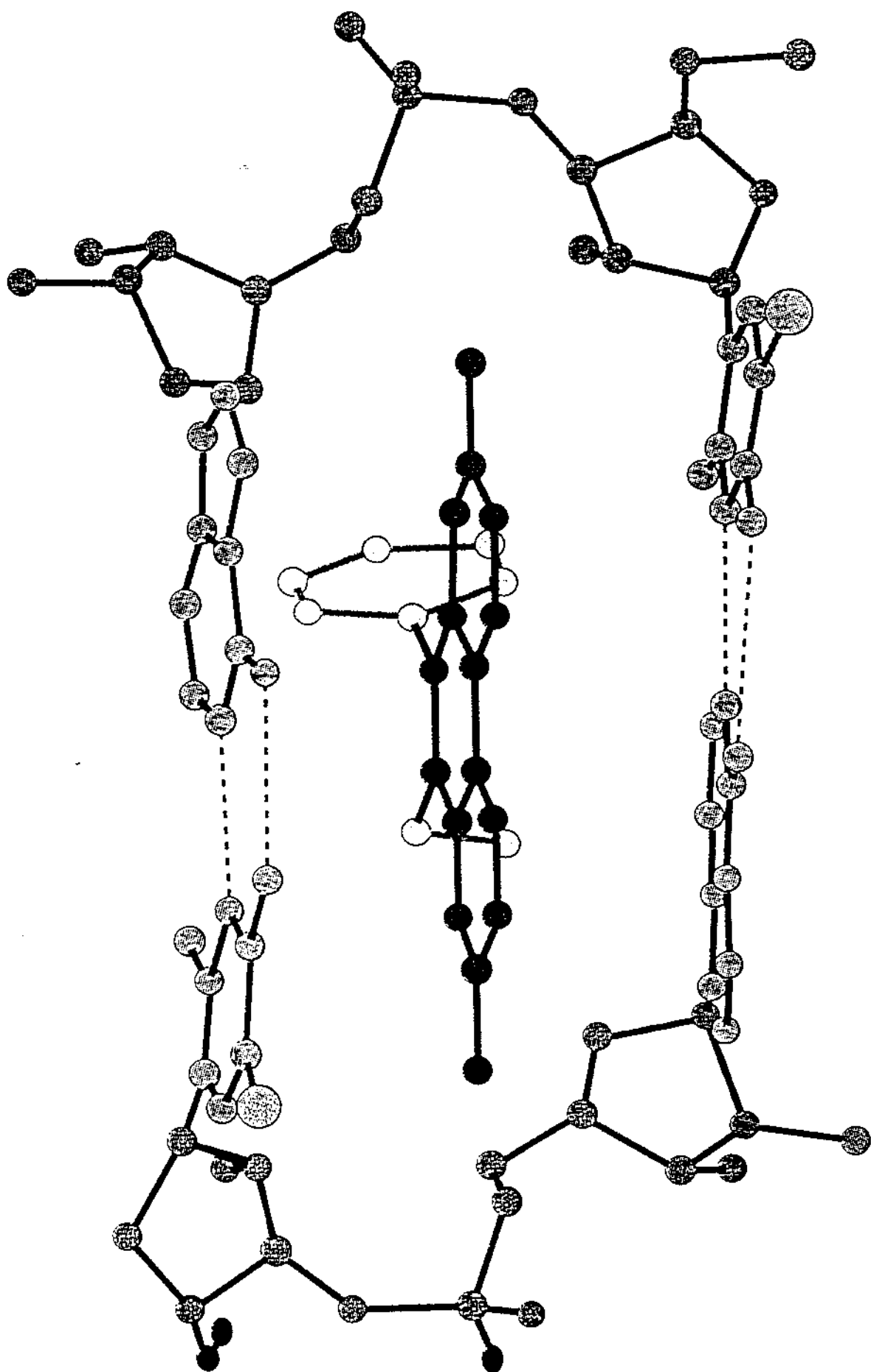
5'-Bromuracil
(seltener Enolzustand)

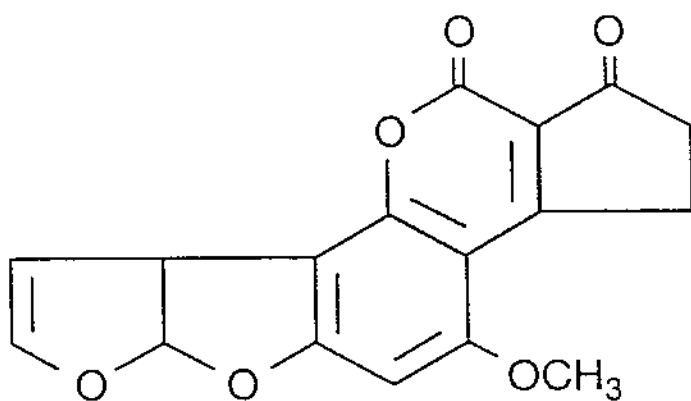


Uracil

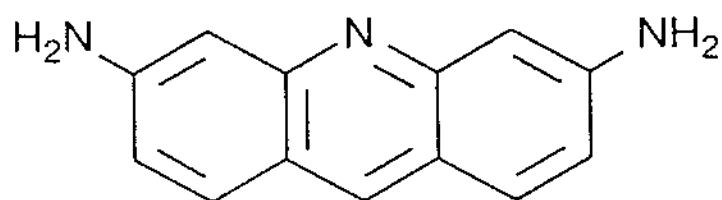


Cytosin

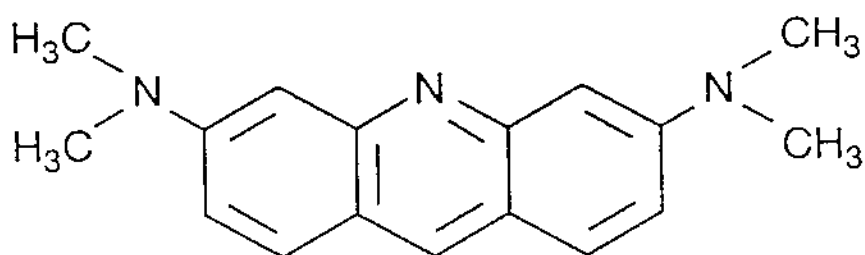




Aflatoxin B₁



Proflavin



Acridinorange