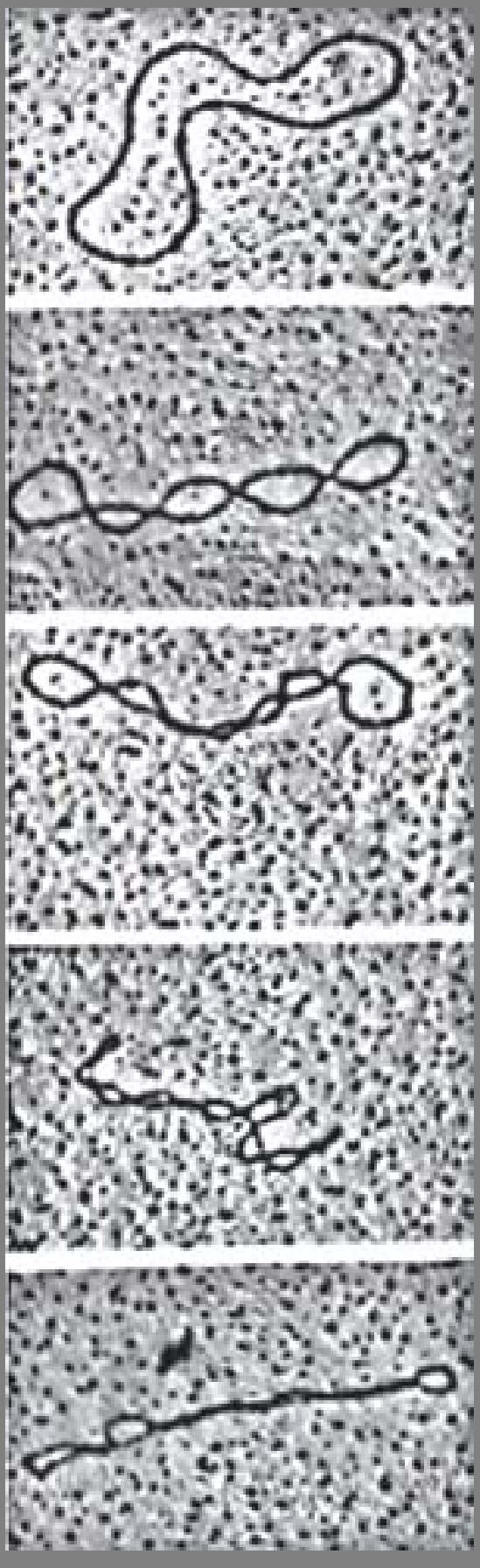
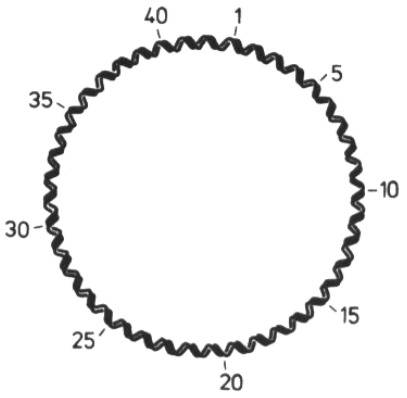
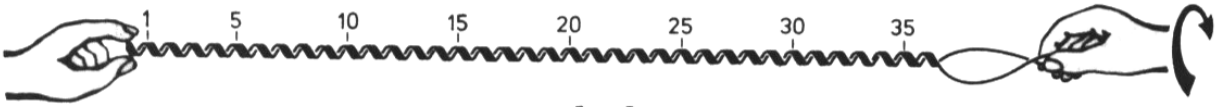


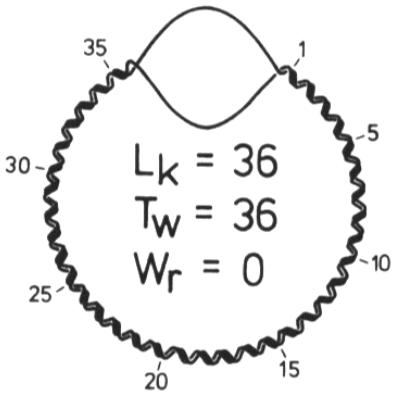


$L_k = 42$
$T_w = 42$
$W_r = 0$

unstrained relaxed

unwind by six
right handed turns
$\Delta L_k = -6$

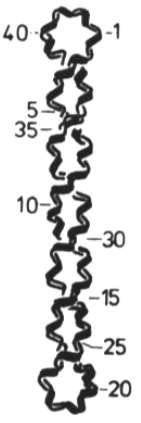




$L_k = 36$
$T_w = 36$
$W_r = 0$

"relaxed"

$L_k = 36$
$T_w = 42$
$W_r = -6$



supercoil

partially unwound

The Linking Number (L) of DNA

- **The linking number of DNA, a topological property, determines the degree of supercoiling;**
- **The linking number defines the number of times a strand of DNA winds in the right-handed direction around the helix axis when the axis is constrained to lie in a plane;**
- **If both strands are covalently intact, the linking number cannot change;**
- **For instance, in a circular DNA of 5400 basepairs, the linking number is 5400/10=540, where 10 is the basepair per turn for type B DNA.**

The Twist (Tw) of DNA

Twist is a measure of the helical winding of the DNA strands around each other.

Given that DNA prefers to form B-type helix, the preferred twist = number of basepair/10;
10 is the number of necleotide in one twist!

The Writhe (Wr) of DNA

- **Writhe is a measure of the coiling of the axis of the double helix.**

A right-handed coil is assigned a negative number (negative supercoiling) and a left-handed coil is assigned a positive number (positive supercoiling).

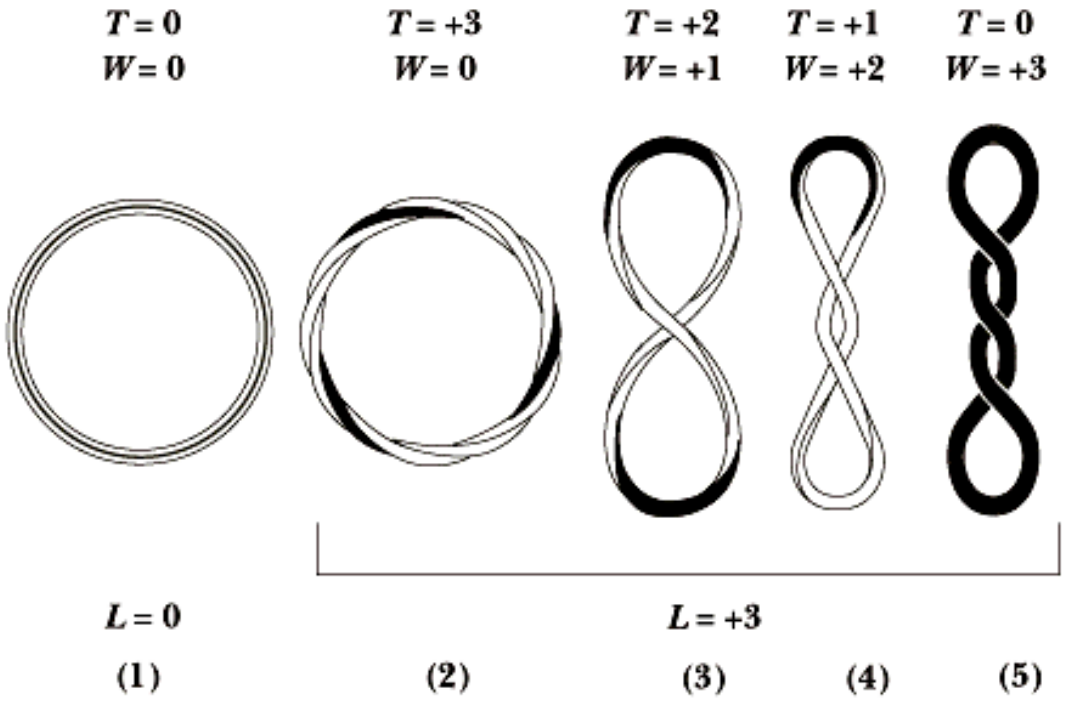
Topology theory tells us that the sum of T and W equals to linking number:

$$L=T+W$$

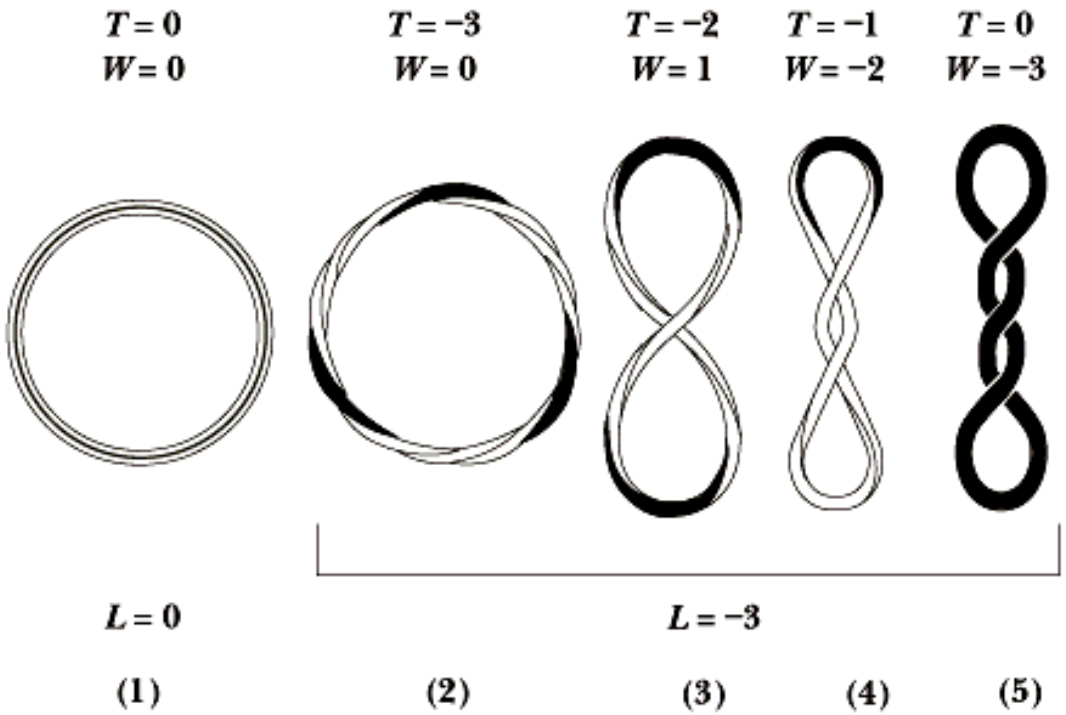
For example, in the circular DNA of 5400 basepairs, the linking number is 5400/10=540

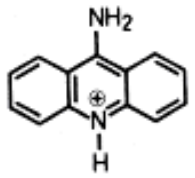
If no supercoiling, then W=0, T=L=540;

(a) Positive supercoiling

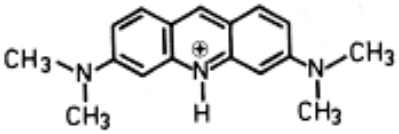


(b) Negative supercoiling

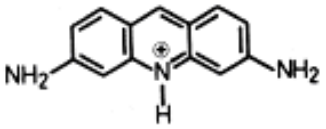




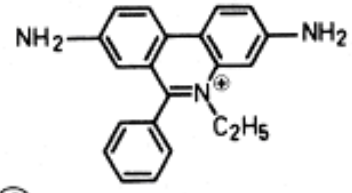
① 9-Aminoacridine



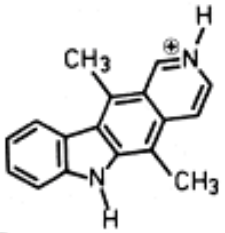
② Acridine orange



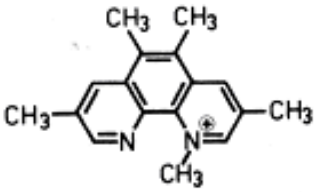
③ Proflavine



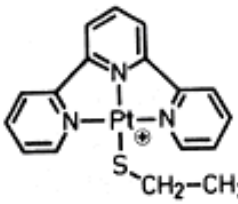
④ Ethidium



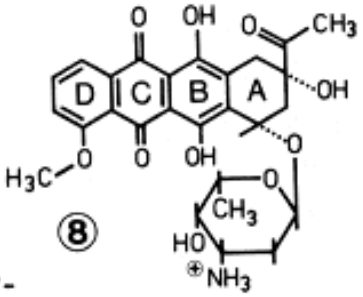
⑤ Ellipticine



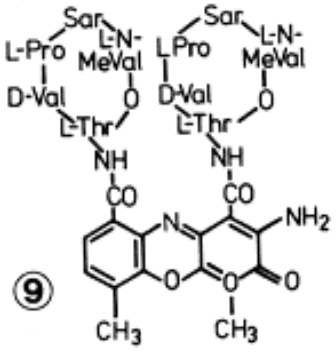
⑥ 3,5,6,8-Tetramethyl-N-methyl phenanthrolinium



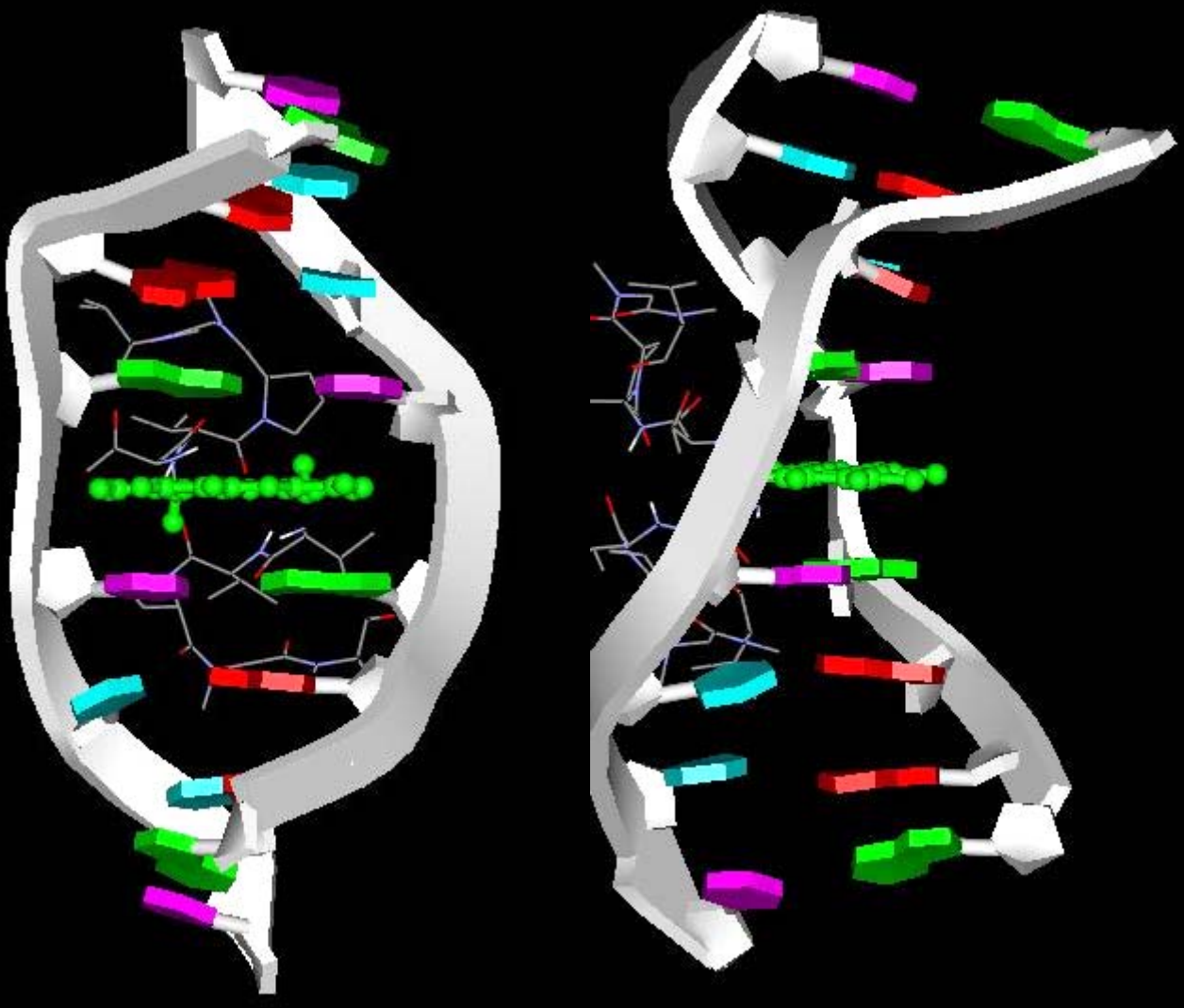
⑦ 2-Hydroxy-ethanethiolato-2,2',2''-terpyridine-platinum (II)

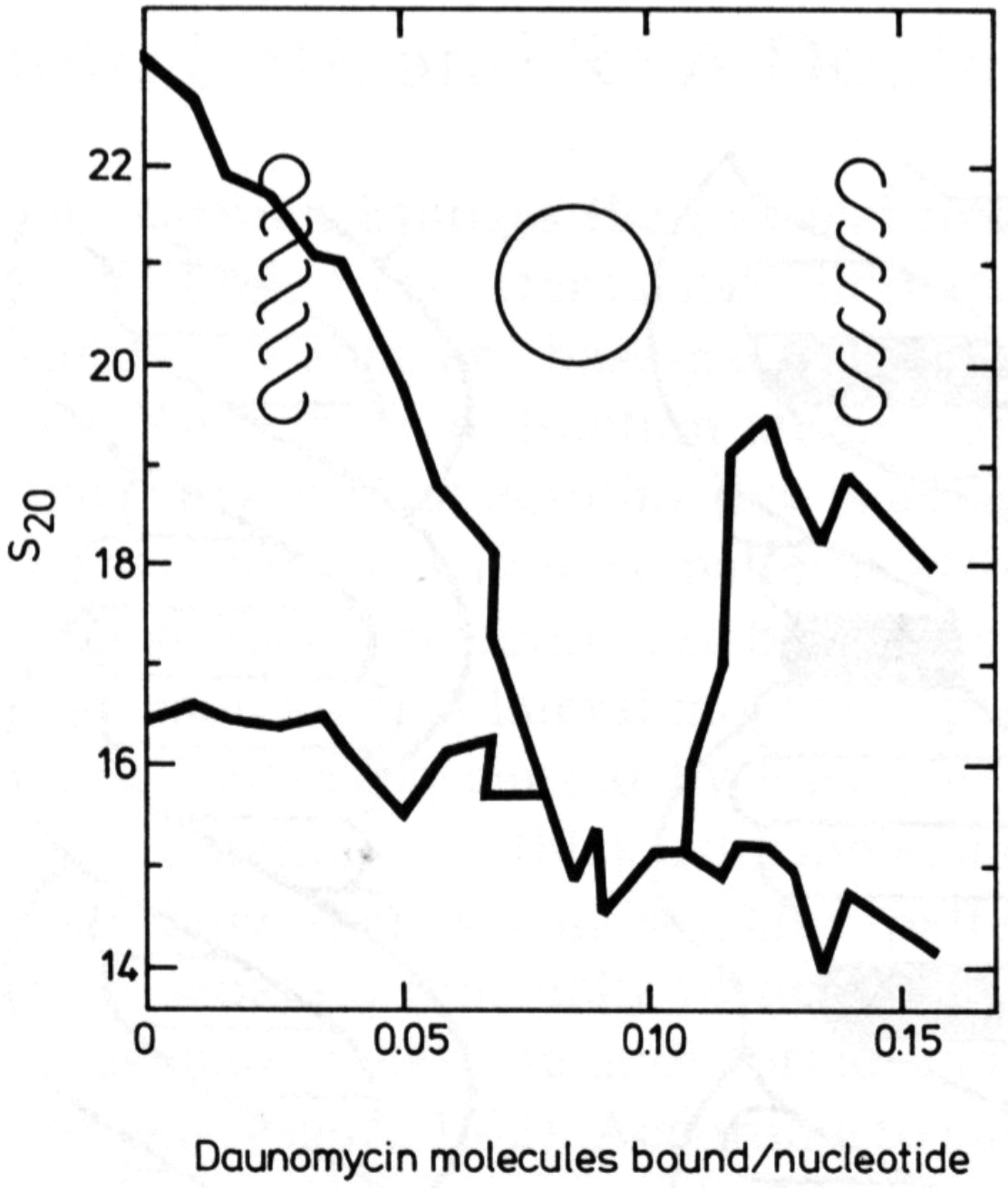


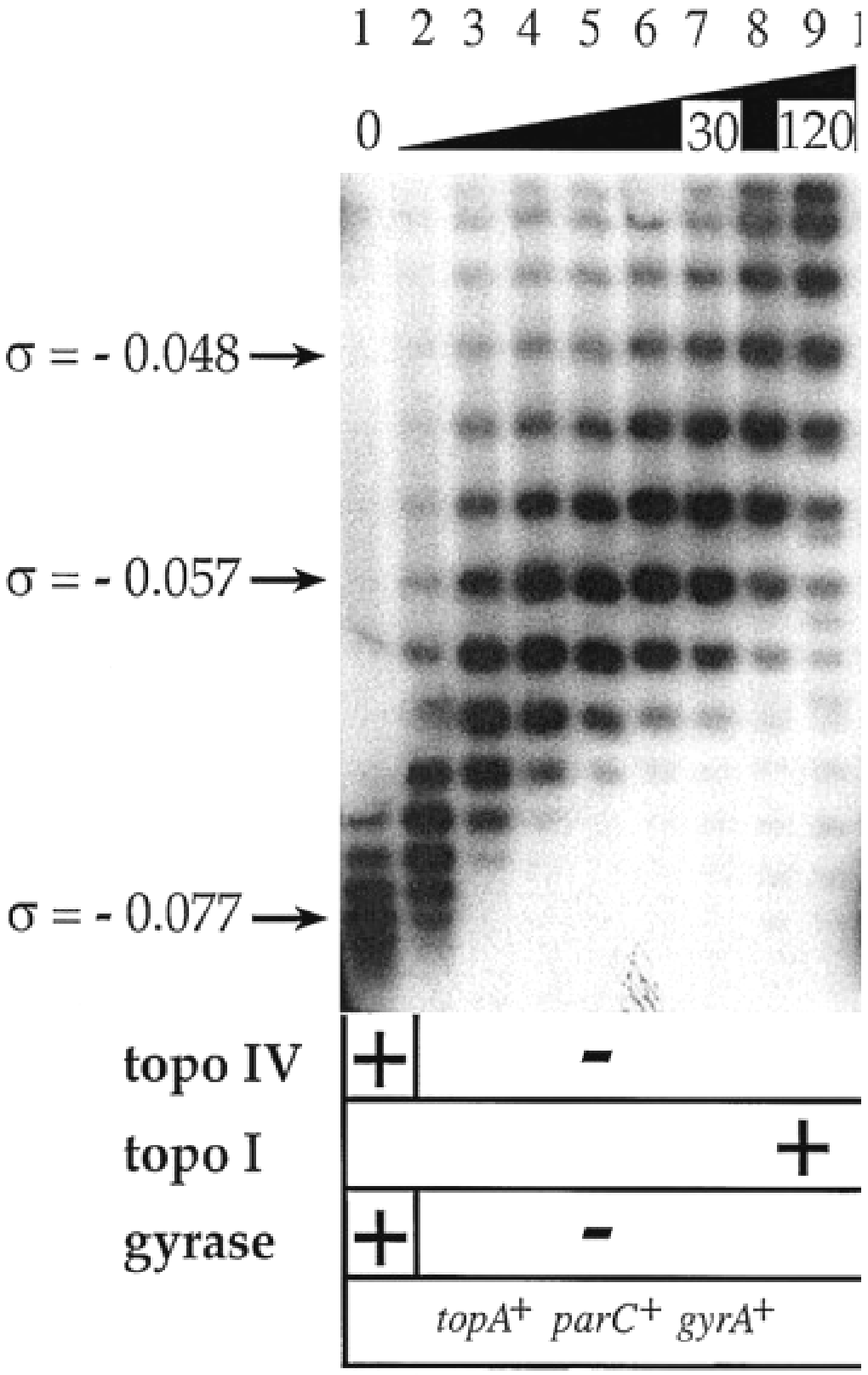
⑧ Daunomycin



⑨ Actinomycin




22
20
18
16
14
s_{20}
0
0.05
0.10
0.15
Daunomycin molecules bound/nucleotide



Zechiedrich et al., J Biol Chem, (2000) 275,8103-8113,