‘Fine tuned model for perfect adaptation’

Spiro et al. PNAS **94**, 7263-7268 (1997)
A model of excitation and adaptation in bacterial chemotaxis

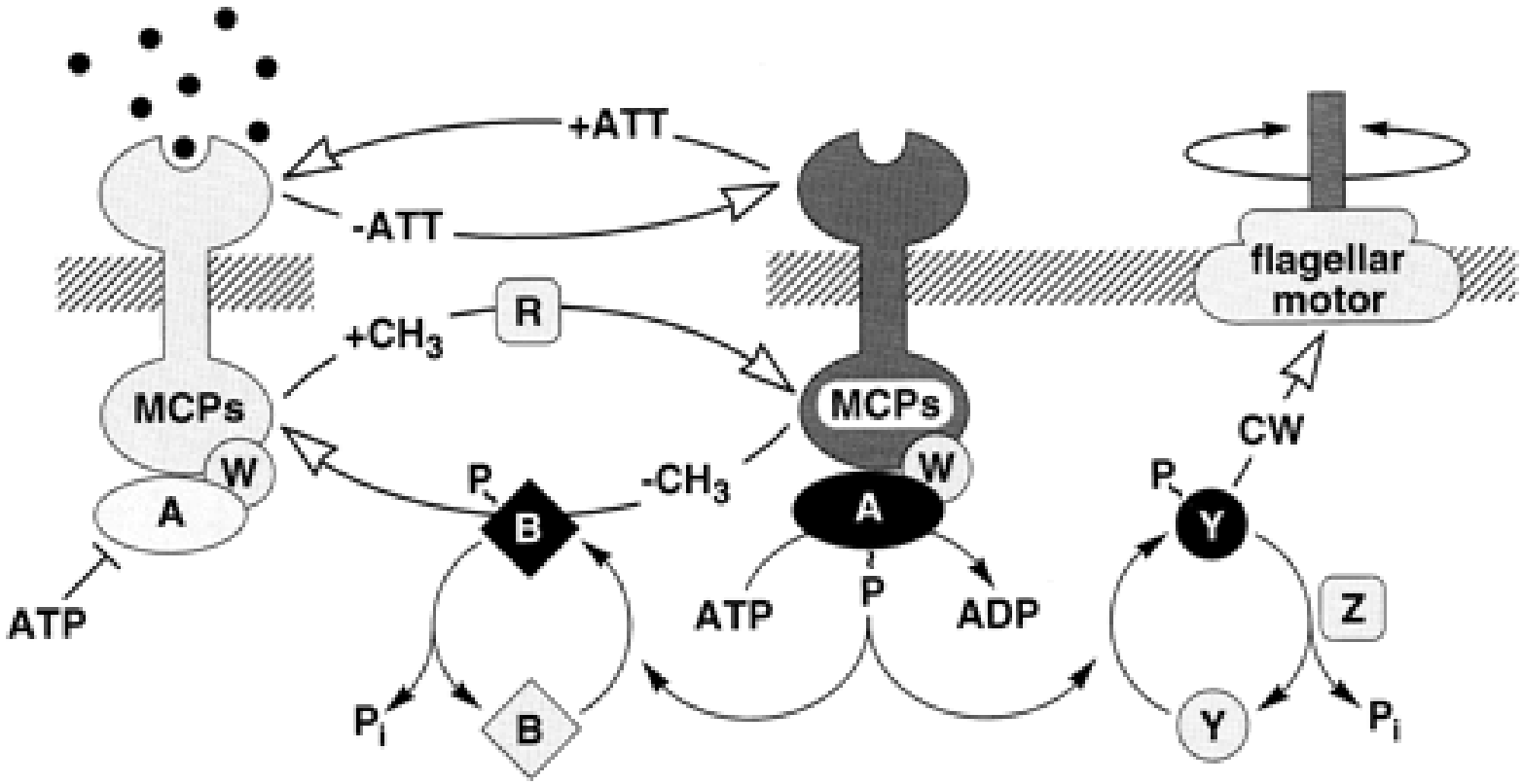


Figure 1 of Spiro, P. A., J. S. Parkinson, and H. G. Othmer. "A model of excitation and adaptation in bacterial chemotaxis." *Proc Natl Acad Sci U S A* 94, no. 14 (Jul 8, 1997): 7263-8.

key player: Tar-CheA-CheW complex

assumptions:

1. Tar is only receptor type, CheW and CheA always bound to Tar
2. Methylation occurs in specific order
3. Consider only 3 highest methylation states
4. Only $CheB_p$ demethylates
5. Phoshorylation of CheA does not affect ligand (un)binding
6. Tar-CheR binding does not affect ligand un(binding) and phosphorylation of CheA
7. CheZ is not regulated
8. Phosphotransfer from complex to CheY or CheB is not affected by occupancy or methylation state.

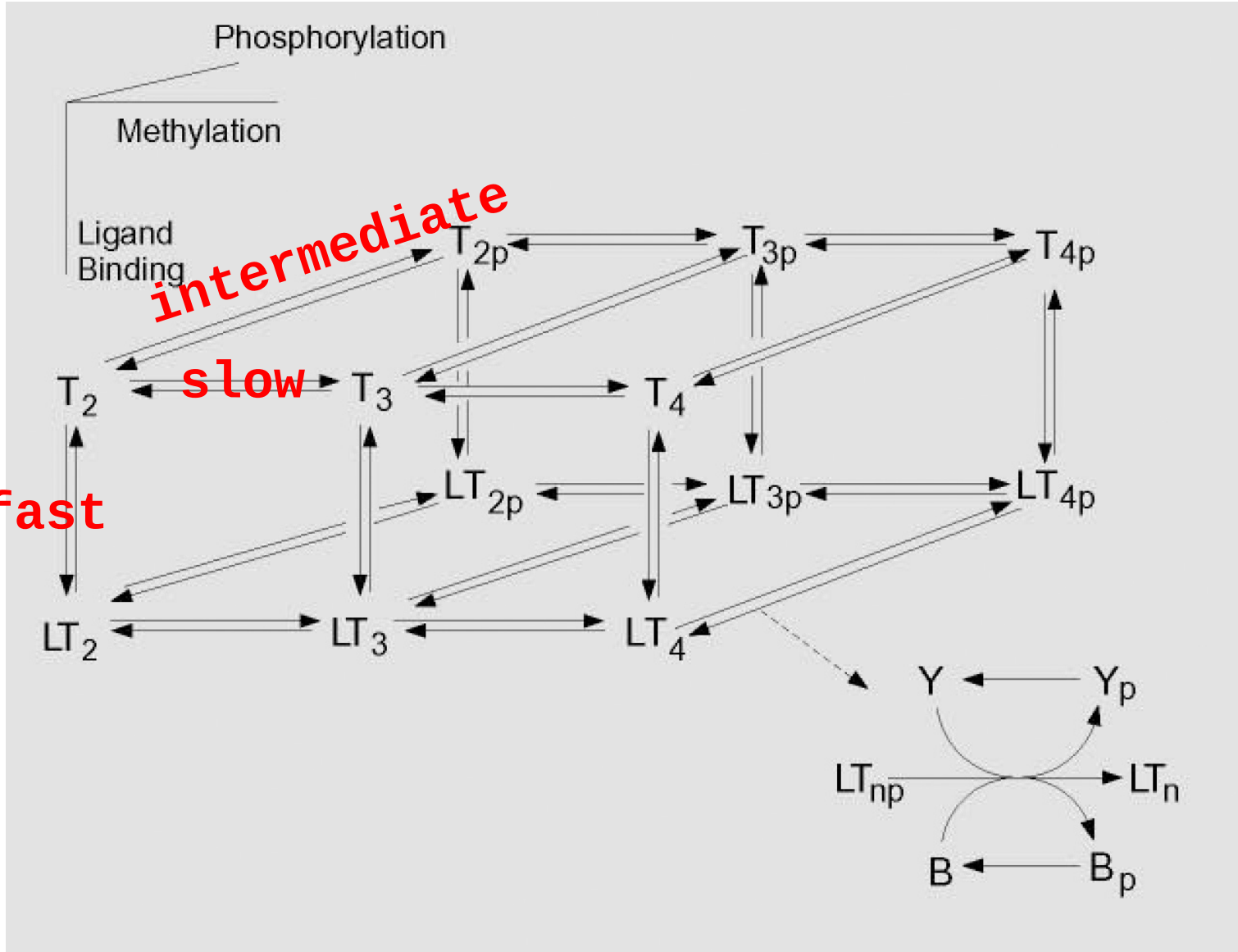
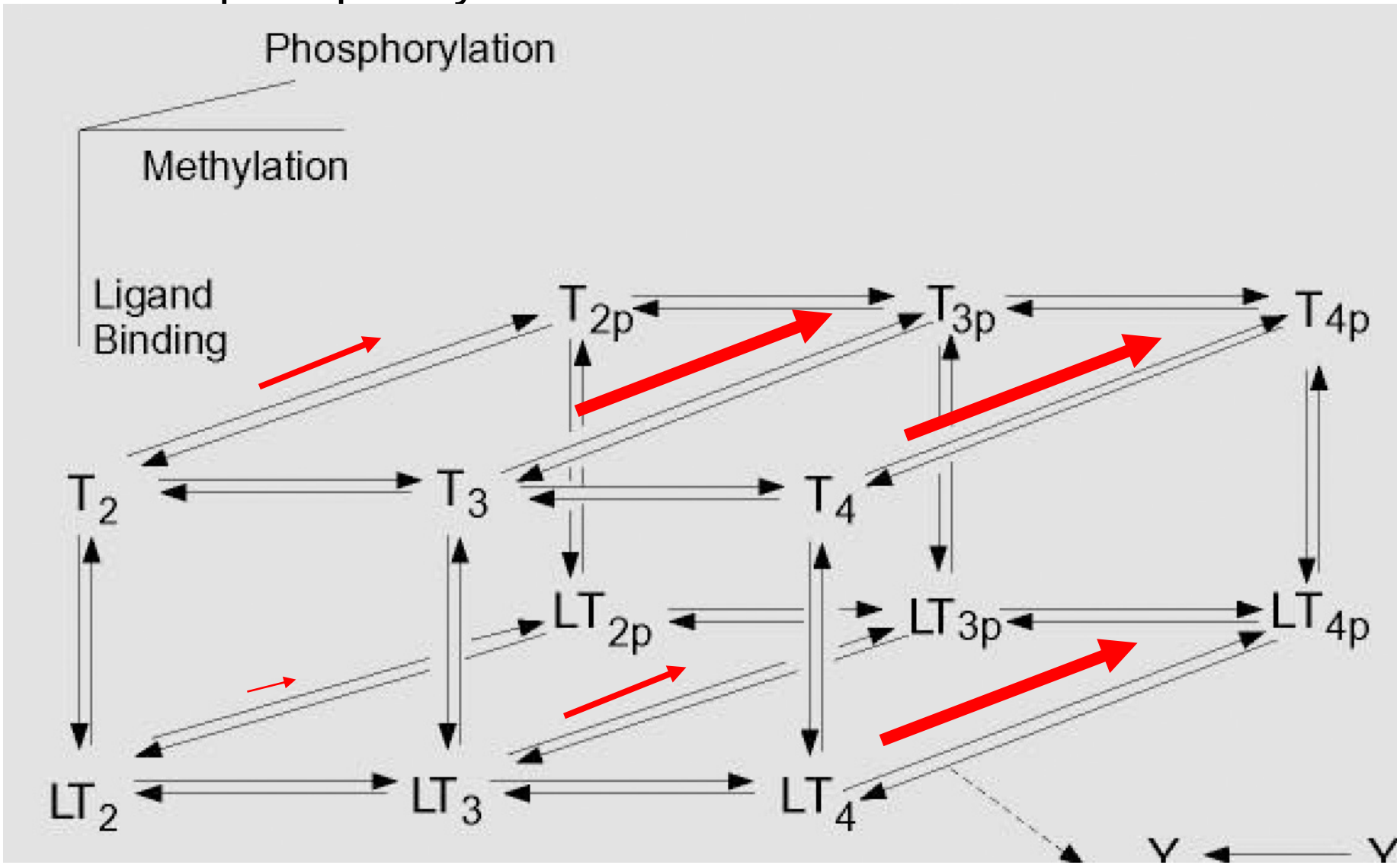


Figure 2 of Spiro, P. A., J. S. Parkinson, and H. G. Othmer. "A model of excitation and adaptation in bacterial chemotaxis." *Proc Natl Acad Sci U S A* 94, no. 14 (Jul 8, 1997): 7263-8.

Ligand bound states generally have lower autophosphoryalation rates



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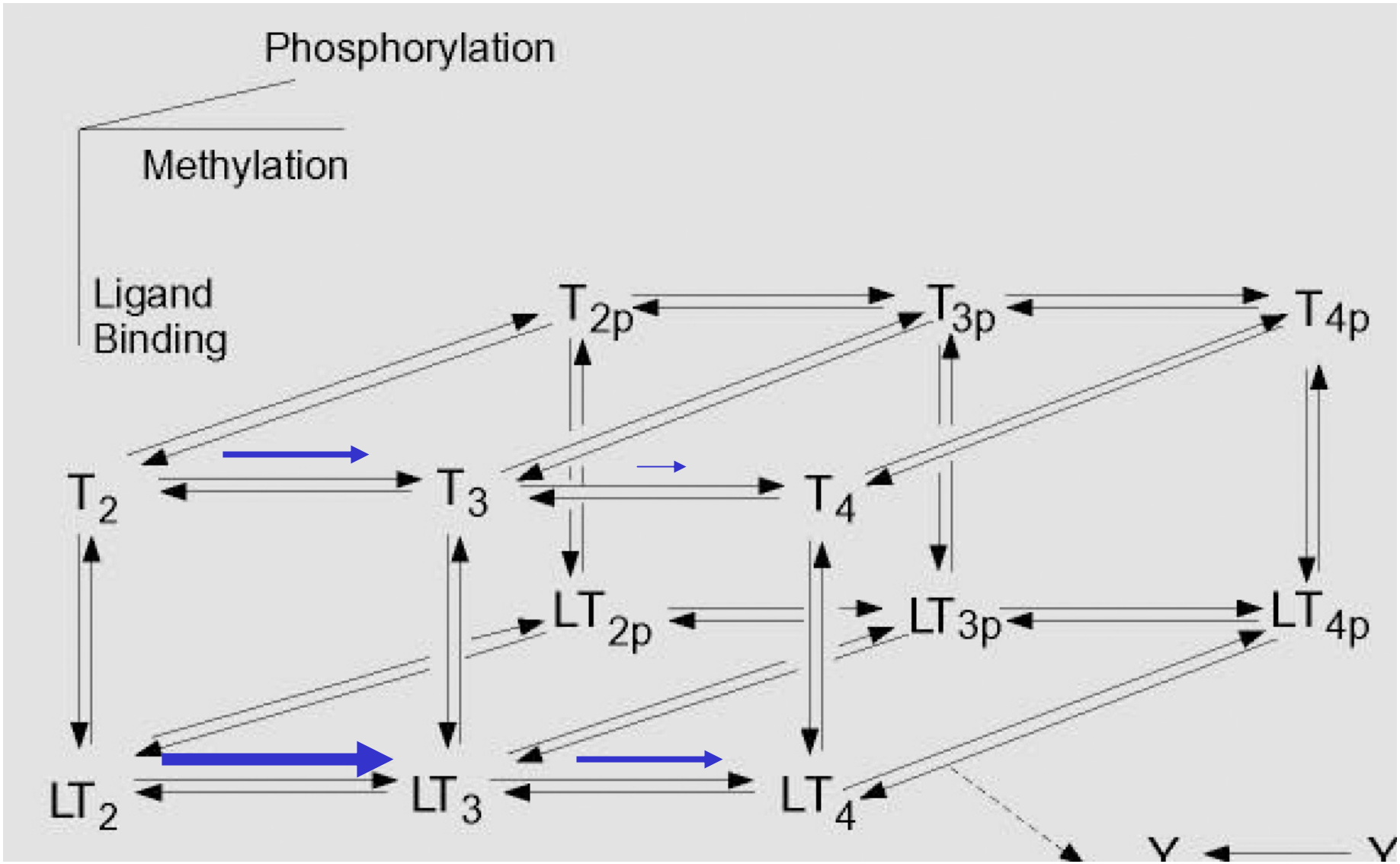
CheR methylates ligand-bound states more rapidly



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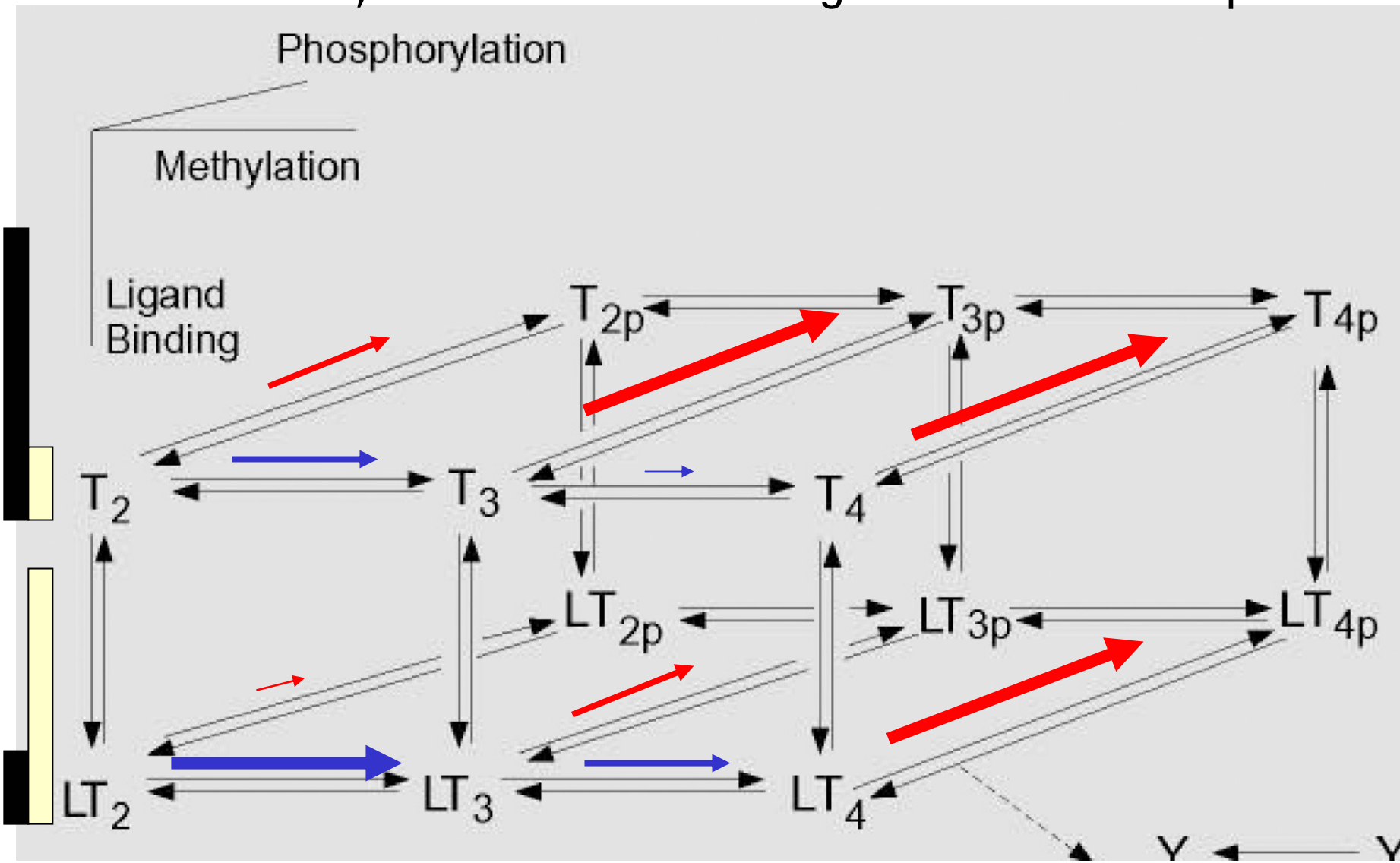
Consider step in aspartate concentration time ~ 1 ms, increase in ligand bound complex



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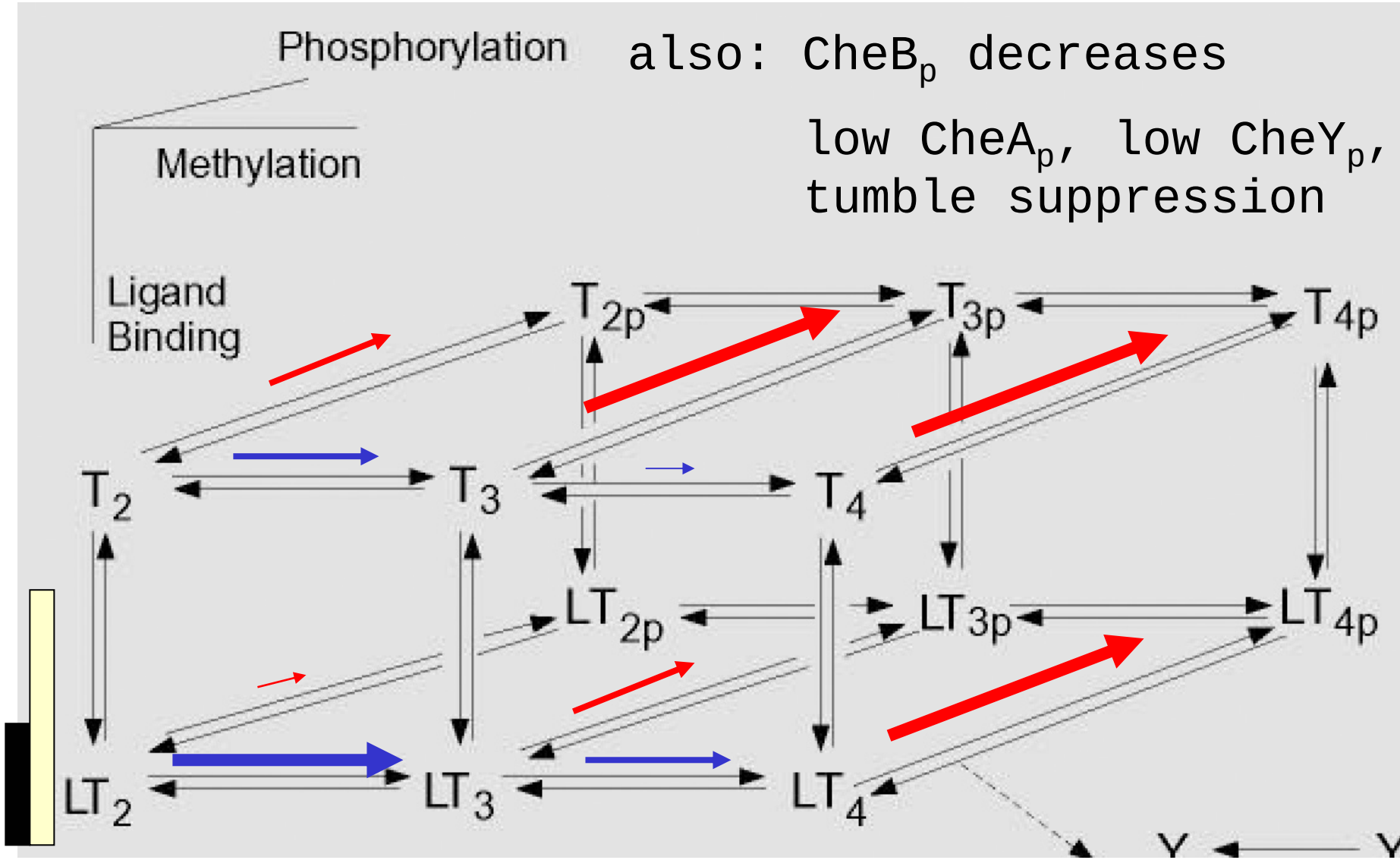
time ~ 5 s, total # of phosphorylated complexes decreases gradually because ligand bound complexes do not autophoshorylate very well



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time ~ 50 s, slowly the complex methylates.
Note that demethylation is switched off
because of low levels of $CheA_p$ (low $CheB_p$).

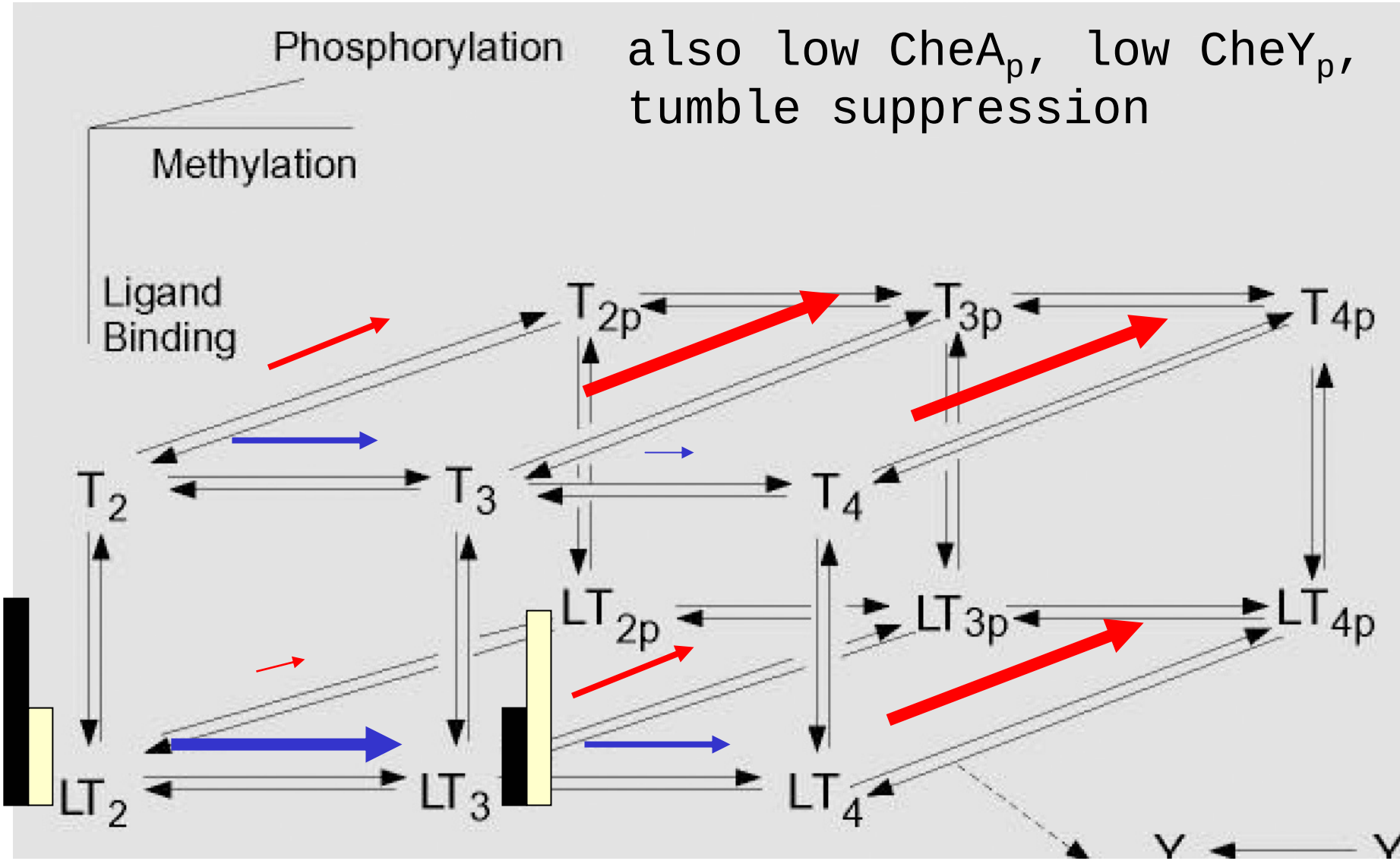

Figure 4 of Spiro, P. A., J. S. Parkinson, and H. G. Othmer.
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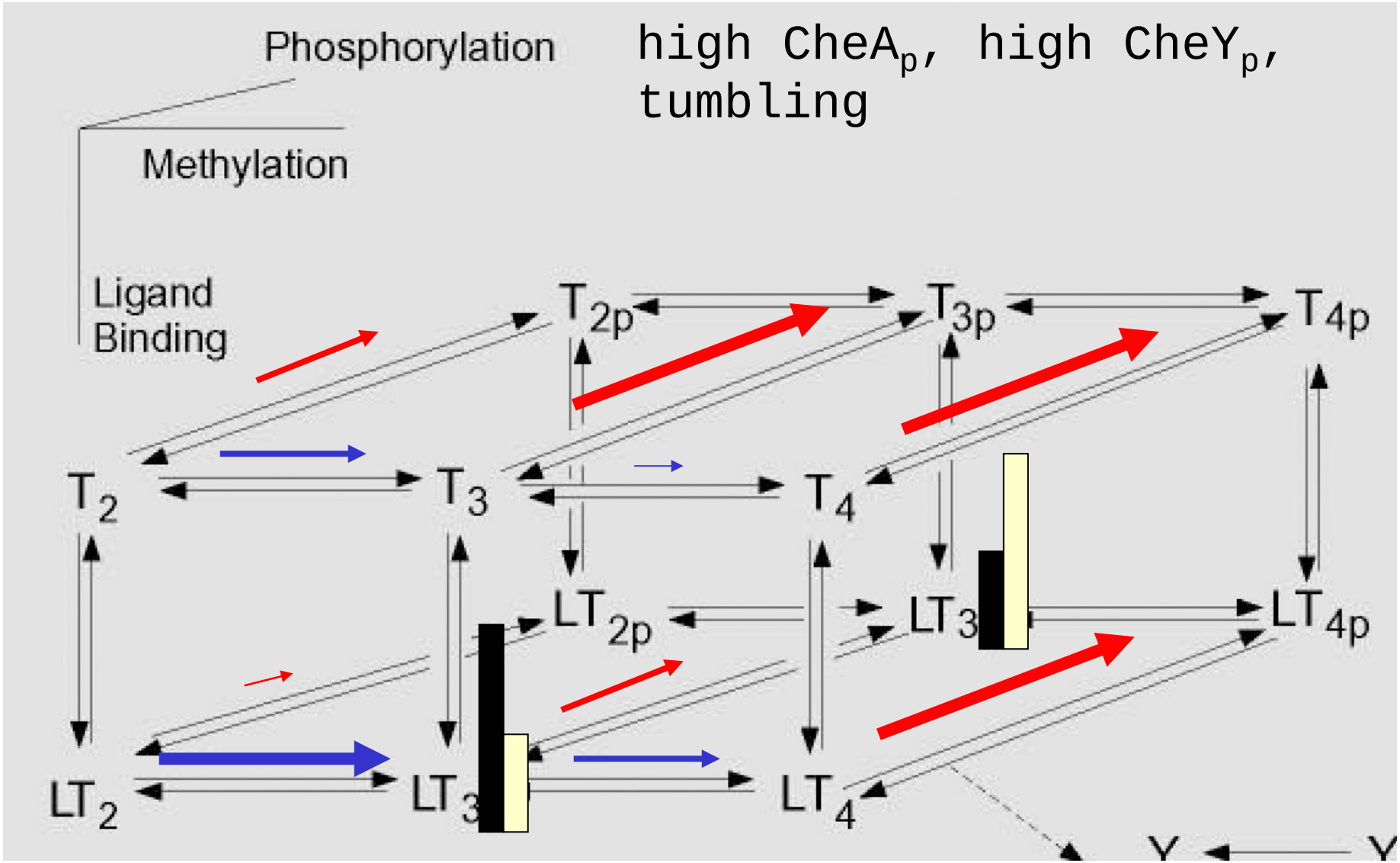
Higher methylation states autophosphorylate easier, so slowly $CheA_p$ adapts to its initial level



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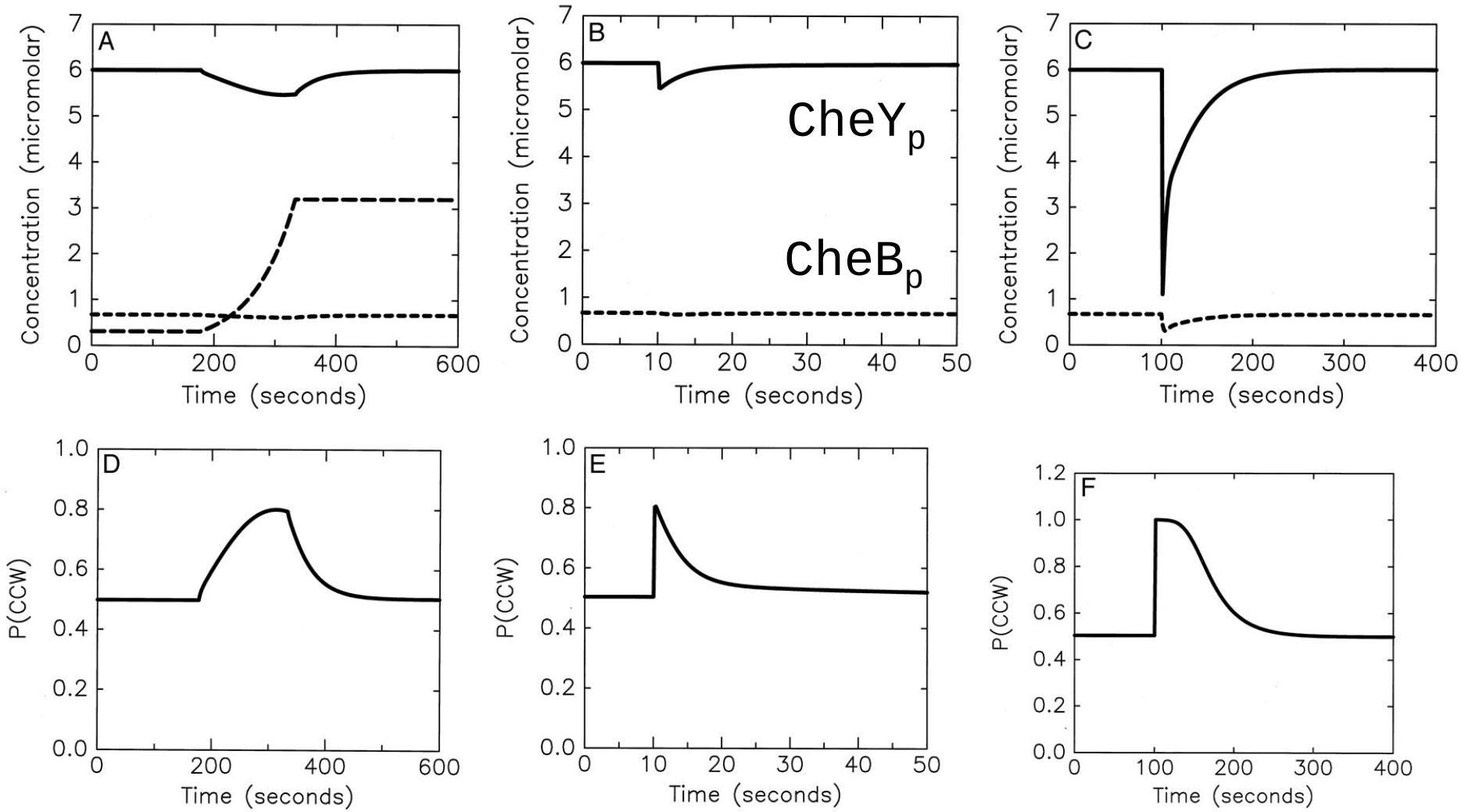

Spiro, P. A., J. S. Parkinson, and H. G. Othmer. Figures 1, 2, and 4 in "A model of excitation and adaptation in bacterial chemotaxis." *Proc Natl Acad Sci U S A* 94, no. 14 (July 8, 1997): 7263-8.

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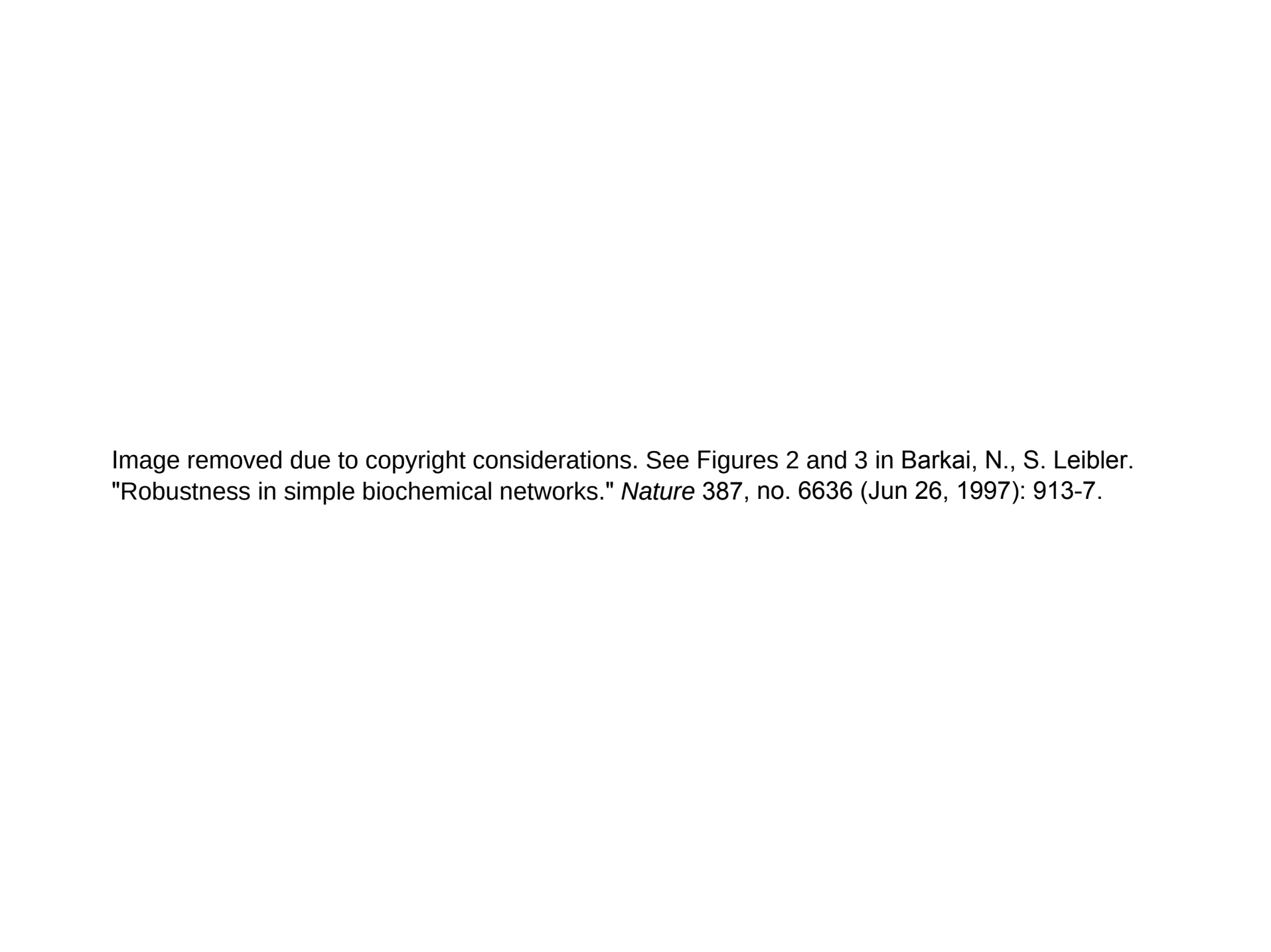
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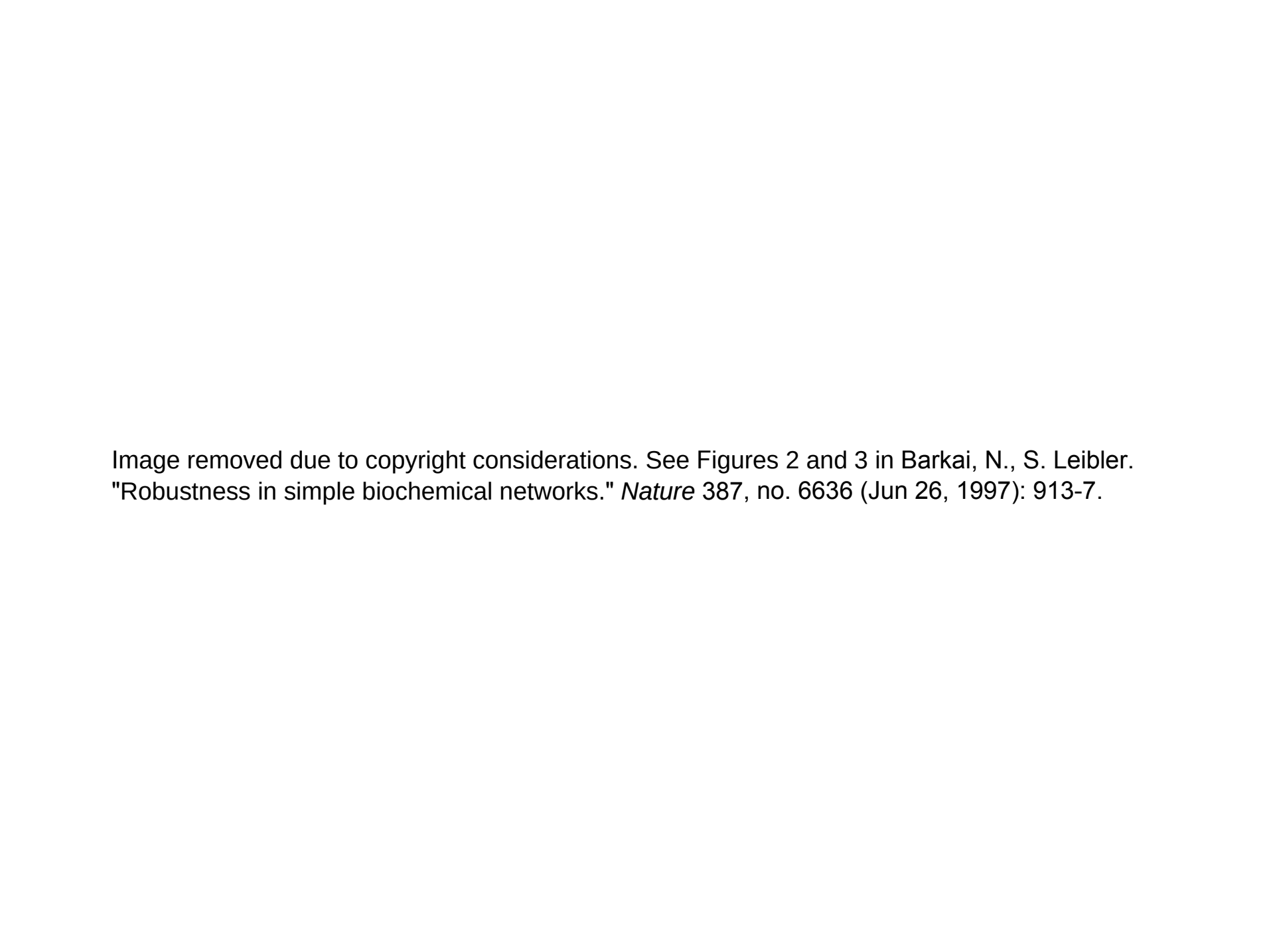
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