Is 3-Methyl[15]*annulenone*-Hydroxy-3-methyl[15]annulenylium Ion Cycle Mimic to Bacteriorhodopsin Cycle?

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Annulenone cycle [Fig. 3] constitutes four state model for light driven H^+-pumping of bacteriorhodopsin (bR) [Fig. 2], satisfying requirements of better H^+-binding in E_1H [Fig. 1] [$K_t = \frac{[E_1]}{[E_2]} < 1$ and $pK_{a\ E_1H} > pK_{a\ E_2H}$]. It also satisfies an essential requirement for the active transport of H^+ by illuminating orange light (>470 nm) [$K_L = \frac{[E_1H]}{[E_2H]} < 1$]. Our annulenone cycle enables us to consider design principles for H^+-pumping. The rate enhancement effects of the 13-methyl group in retinal Schiff's base for the regeneration of B_{568} from $M_{412(I)}$ could be representable in the annulenone cycle by introducing one Me group into the parent [15]annulenone molecule [Me in place of H at the 3-position].

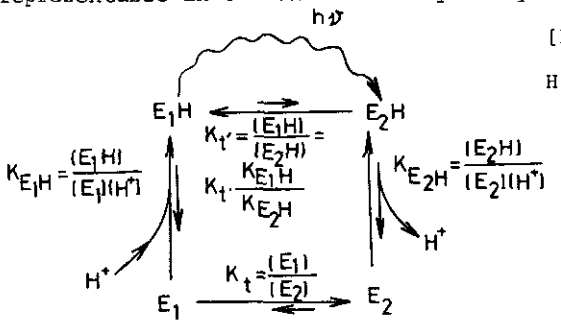

Fig. 1 Four state model for light-driven H^+-pumping in bR or annulenone cycle. (Three essential equilibrium constants are shown).

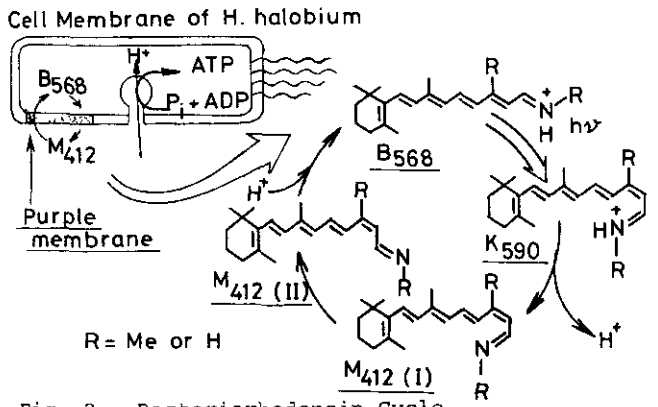

Fig. 2 Bacteriorhodopsin Cycle
(K. Schulten and P. Tavan, 1978)

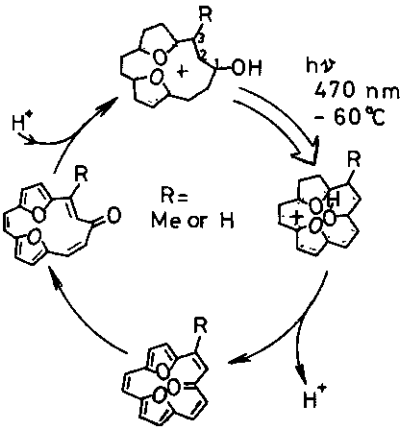

Fig.3 Annulenone Cycle
(H. Ogawa et al. 1980)