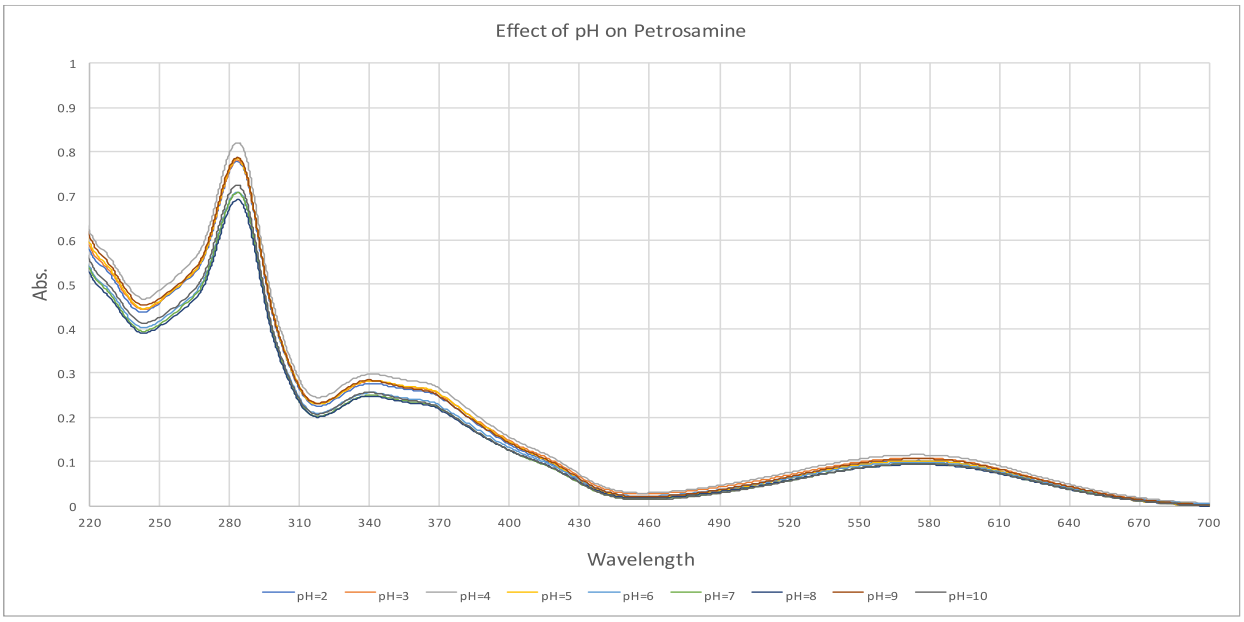
Supporting Information

Petrosamine Revisited. Experimental and Computational Investigation of Solvatochromism, Tautomerism and Free Energy Landscapes of a Pyridoacridinium Quaternary Salt.

Christopher Gartshore[1], Yongxuan Su[1] and Tadeusz F. Molinski[1,2,]*

1 Department of Chemistry and Biochemistry, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093, USA MC3568; gartcj@gmail.com
2 Skaggs School of Pharmacy and Pharmaceutical Sciences, University of California, San Diego, 9500 Gilman Drive MC3568, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093, USA.
* Correspondence: tmolinski@ucsd.edu

Figure S1. UV-vis spectra of **1**. pH dependence in in Britton-Robinson buffer[1] (pH 2 – 10, normalized)



[1]Britton, H. T. K.; Robinson, R. A. CXCVIII.—Universal buffer solutions and the dissociation constant of veronal. *J. Chem. Soc.* **1931**, 1456-1462.

Figure S2. FTIR spectrum of **6b**

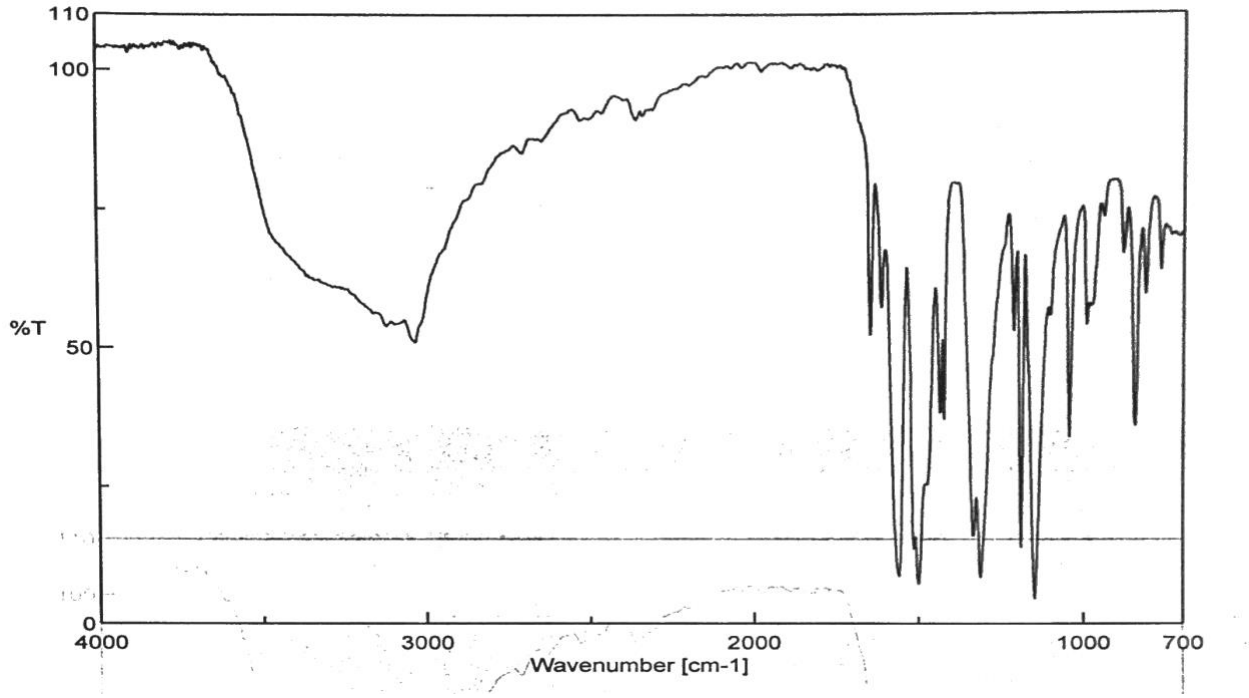


Figure S3. UV-vis spectrum of 6b in acetone (lmax2 = .

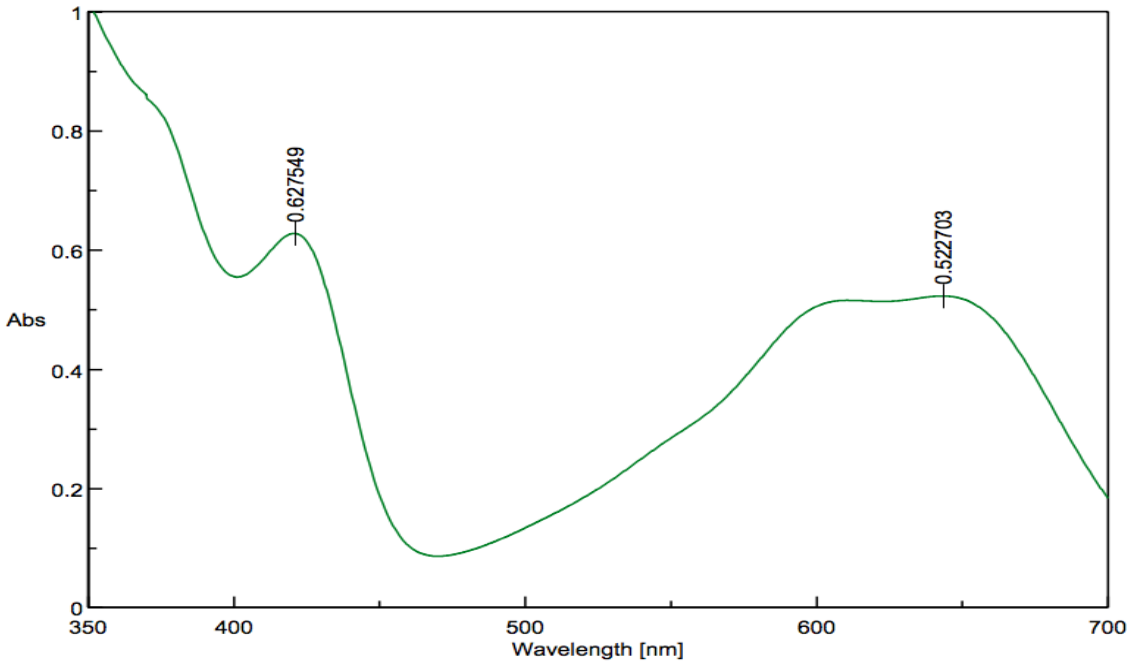
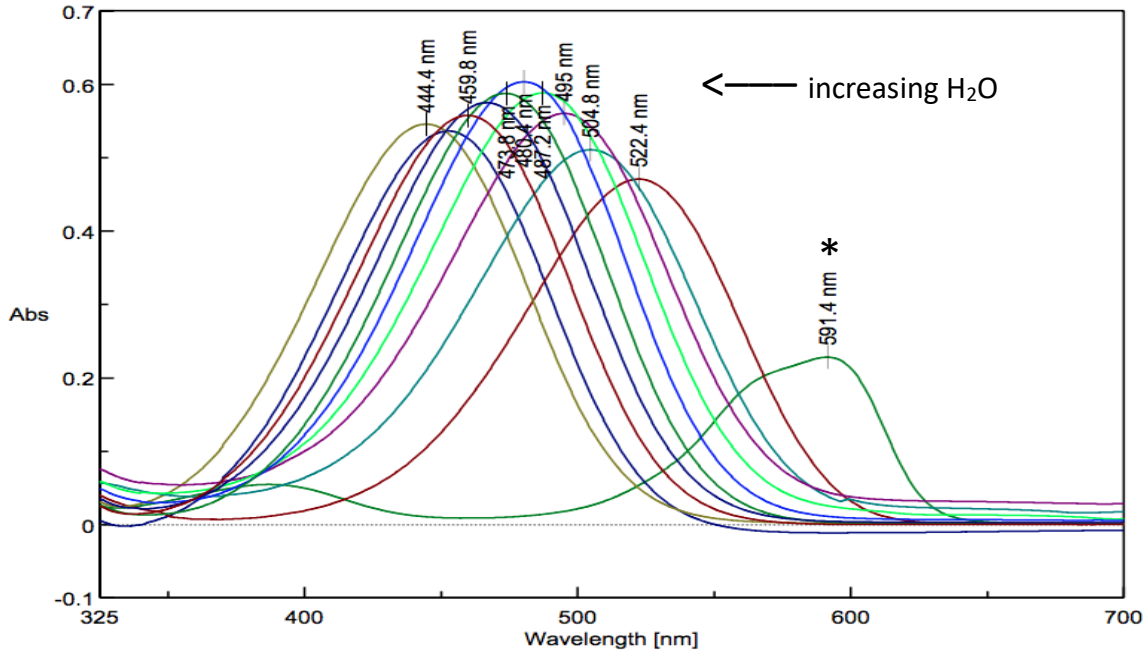


Figure S4. UV-vis spectra of **6b** in acetone-H_2O mixtures[1] (normalized).



[1]Each with 5 µL nBu$_4$N$^+$ HO$^-$: 0% H_2O*, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100%).

Table S1. λ_{max} and absorbance of merocyanine dye **6b** in H_2O-acetone mixtures.

%H_2O (v/v)	λ_{max2}[1]	Absorbance
0	591.4	0.227779
10	522.4	0.459048
20	504.8	0.510442
30	495.0	0.559982
40	487.2	0.587949
50	480.4	0.603025
60	473.8	0.587191
70	466.8	0.574550
80	459.8	0.557193
90	450.8	0.535364
100	444.4	0.545338

[1]See text for definition of 'band-1' and 'band-2'

Figure S5. In situ ESIMS measurements of the rate of H-D exchange of **1** in CD_3OD.[1]

[1]'*t* = 0' values normalized to a solution of **1** CH_3OH

S6. Derivation of kinetic parameters of H-D exchange of petrosamine (**1**) in CD_3OD and uncertainty analysis.

Petrosamine (**1**) was dissolved in CD_3OD and aliquots of the solution sampled by ESIMS every 15 s from 15 s to 120 s. Three replicate runs were completed.

Assuming the kinetics of each of the two elemental steps in H-deuterium exchange reaction follow first-order rate laws and that the reverse reactions can be ignored (high concentration of CD_3OD), the following analysis is valid (note: A = **1**-d_0, B = **1**-d_1 and C = **1**-d_2,

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

The reaction rate of A, B and C could be defined by eq. (1)-(3), and their initial concentrations were shown in eq (4)

$$\begin{cases} \frac{d[A]}{dt} = -k_1[A] & (1) \\ \frac{d[B]}{dt} = k_1[A] - k_2[B] & (2) \\ \frac{d[C]}{dt} = k_2[B] & (3) \\ [A]_0 = 1,\ [B]_0 = [C]_0 = 0 & (4) \end{cases}$$

The solution to the system of the differential equations above were shown in eq (5)-(7) (also see *note*):

$$[A]_t = e^{-k_1 t} \quad (5)$$

$$[B]_t = \frac{k_1(e^{-k_2 t} - e^{-k_1 t})}{k_1 - k_2} \quad (6)$$

$$[C]_t = \frac{k_2 e^{-k_1 t} - k_1 e^{-k_2 t}}{k_1 - k_2} + 1 \quad (7)$$

k_1 could be obtained by fitting experimental [A] to eq (5) using nonlinear regression or linear regression.

k_2 could be obtained by fitting experimental [B] to eq (6) using nonlinear regression or by fitting experimental [C] to eq (7) using nonlinear regression, using k_1 value obtained from eq (5).

Fitting k_1 and k_2 simultaneously to (6) or (7) was possible, but it generated a large error in k_1 and therefore k_1 was obtained by using eq (5) only.

Only the data in first 45 s of reaction were used for k_1 fitting, and the data in the first 60 s were used for k_2 fitting.

Note:

eq (6) and eq (7) were only valid when $k_1 \neq k_2$. When $k_1 = k_2 = k$, they became:

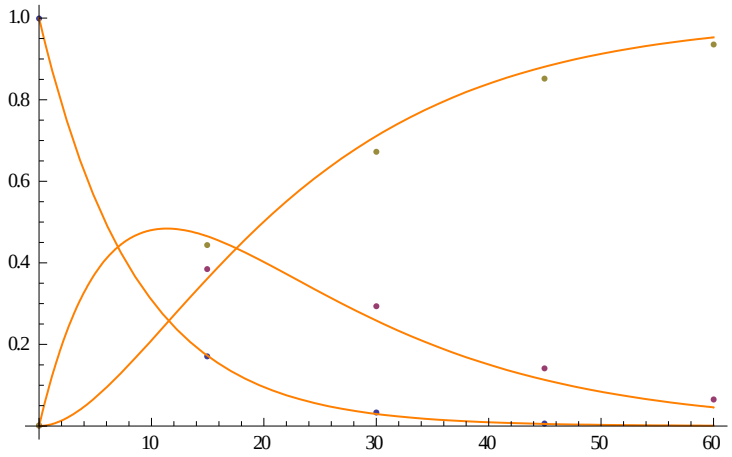
$$[B]_t = kte^{-kt} \quad (8)$$

$$[C]_t = 1 - e^{-kt} - kte^{-kt} \quad (9)$$

It could be demonstrated that eq (6) and (7) converged to (8) and (9) when $k_1 - k_2 \rightarrow 0$ using Taylor expansion.

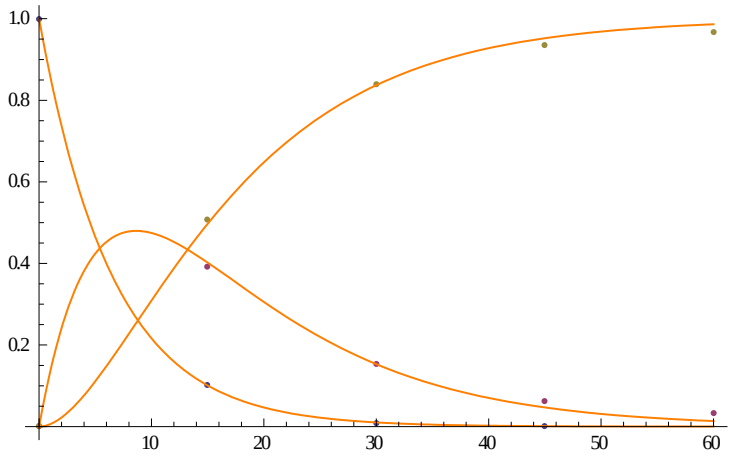
1st Run (Run B):

	k (s^{-1})	Standard Error (σ)	95% Confidence Interval	R^2
k_1 (fitting to eq. 5)	0.1175	0.0009	{0.1147, 0.1203}	0.99998
k_2 (fitting to eq. 6)	0.0638	0.0063	{0.0463, 0.0813}	0.97
k_2 (fitting to eq. 7)	0.0635	0.0064	{0.0456, 0.0814}	0.996



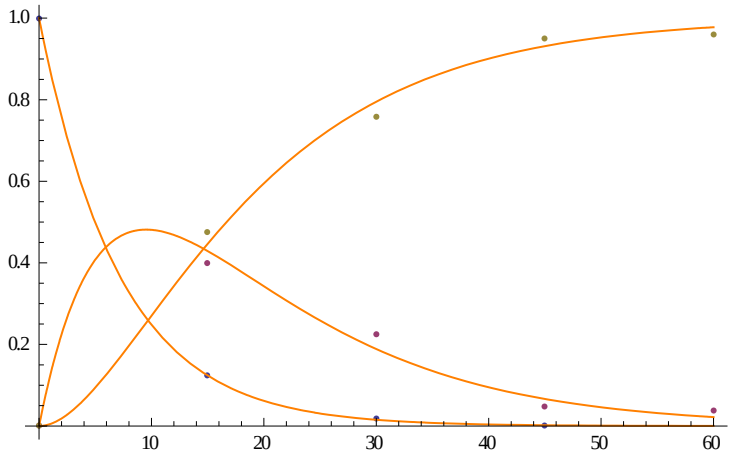
2nd Run (Run C):

	k (s^{-1})	Standard Error (σ)	95% Confidence Interval	R^2
k_1 (fitting to eq. 5)	0.1531	0.0007	{0.1507, 0.1555}	0.999996
k_2 (fitting to eq. 6)	0.0850	0.0028	{0.0772, 0.0927}	0.996
k_2 (fitting to eq. 7)	0.0850	0.0029	{0.0769, 0.0932}	0.9997



3rd Run (Run D):

	k (s^{-1})	Standard Error (σ)	95% Confidence Interval	R^2
k_1 (fitting to eq. 5)	0.1394	0.0007	{0.1371, 0.1417}	0.999994
k_2 (fitting to eq. 6)	0.0767	0.0046	{0.0641, 0.0893}	0.99
k_2 (fitting to eq. 7)	0.0765	0.0047	{0.0634, 0.0896}	0.999



Although k_1 and k_2 showed some variation between runs, it is interesting to observe that k_2/k_1 = 0.55 among all three runs.

Summary:

1. Run #1 (B) $k_1 = 0.11750(9)\ s^{-1}$, $k_2 = 0.0635(64)\ s^{-1}$ R^2 =0.99998 Eqn. 5
2. Run #2 (C) $k_1 = 0.1531(7)\ s^{-1}$, $k_2 = 0.0850(29)\ s^{-1}$ R^2 =0.99996 Eqn. 7
3. Run #3 (D) $k_1 = 0.1394(7)\ s^{-1}$, $k_2 = 0.0765(47)\ s^{-1}$ R^2 =0. 999994 Eqn. 7