

Paul F. Cranefield Award to Baron Chanda

The late Paul F. Cranefield, MD, PhD, was the editor of *The Journal of General Physiology* for 30 years, from 1966 to 1995. During his editorship, Dr. Cranefield worked tirelessly to advance the mission of the Journal: to promote and publish original research of the highest quality that elucidates basic biological, chemical, or physical mechanisms of broad physiological significance, and provides insight into fundamental mechanisms that govern biological function at all levels.

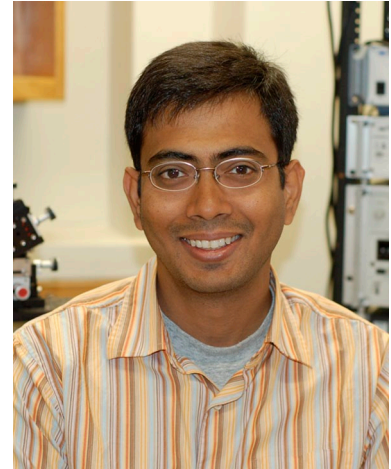
When Dr. Cranefield stepped down as editor, the Council of the Society of General Physiologists created the Paul F. Cranefield Award to recognize his enduring contributions to the Journal and the Society, and to carry on his vision of excellence. The award was to be given to a young, independent investigator who in the preceding year published an article of exceptional quality in the Journal. The award would be given at the Annual Meeting and Symposium of the Society in Woods Hole, MA. It was also decided that the award would only be given to a candidate that met stringent criteria, with the result that it has not been given every year.

In 2013, the leadership of the Society selected Baron Chanda of the University of Wisconsin for the Cranefield Award. Dr. Chanda graduated with a B.S. in biochemistry from the University of Delhi in 1991. He received his PhD in biotechnology from the National Center for Biological Sciences in India in 2000 for research in which he developed a novel spectroscopic assay of purified ion channels in liposomes (Chanda and Mathew, 1999). From 2000 through 2005 he was a postdoctoral fellow in the laboratory of Francisco Bezanilla, where he used voltage-clamp fluorimetry to investigate the movement of the voltage-sensing domains (VSDs) of voltage-gated sodium channels (Chanda and Bezanilla, 2002; Chanda et al., 2004), culminating in work showing that the voltage-driven gating charge movement involves an unexpectedly limited movement of the voltage sensors (Chanda et al., 2005a). Dr. Chanda went on to develop optogenetic probes for measuring neuronal electrical activity with high temporal and spatial resolution (Chanda et al., 2005b), and is developing mouse lines in which these probes are constitutively expressed. In 2006, Dr. Chanda assumed the position of assistant professor of physiology at the University of Wisconsin, where he was promoted to associate professor in 2012.

Dr. Chanda was given the Cranefield Award for a paper developing and testing a thermodynamically rigorous

method for extracting the chemical component of the conformational free energy change between the fully closed and fully open state of an ion channel from analysis of Q/V curves (Chowdhury and Chanda, 2012); see commentary by Miller (2012). This analysis obviates the restrictive, usually inappropriate and in many cases demonstrably erroneous assumption implicit in the Boltzmann formulation, namely that at every membrane potential the channels exist only in the two extreme states, fully open or completely closed. Rather, Chowdhury and Chanda extract a nonparametric value, the median voltage (V_m), from Q/V curves and, using mathematical reasoning related to that of Wyman's (1967) classic analysis of allostery in binding, establish that V_m is a model-free macroscopic measure of the chemical free energy difference between the open and closed states. The applicability of the approach was subsequently extended (Chowdhury and Chanda, 2013), and its validity and value further confirmed in a recent study of the BK channel (Sigg, 2013).

The work for which Dr. Chanda received the Cranefield Award comprises only a small portion of his group's research on voltage-gated ion channels, which includes several contributions to the mechanism of anesthetic action (Muroi and Chanda, 2009; Arcisio-Miranda et al., 2010; Muroi et al., 2010), and ongoing efforts characterizing the kinetics of movement of the VSD IV domain, which have established that pore opening precedes inactivation (Capes et al., 2013; Goldschen-Ohm et al., 2013). Overall, Dr. Chanda's research clearly exemplifies in its quality, rigor, and insight into fundamental mechanisms the ideal of the Cranefield Award.



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REFERENCES

- Arcisio-Miranda, M., Y. Muroi, S. Chowdhury, and B. Chanda. 2010. Molecular mechanism of allosteric modification of voltage-dependent sodium channels by local anesthetics. *J. Gen. Physiol.* 136:541–554. <http://dx.doi.org/10.1085/jgp.201010438>
- Capes, D.L., M.P. Goldschen-Ohm, M. Arcisio-Miranda, F. Bezanilla, and B. Chanda. 2013. Domain IV voltage-sensor movement is both sufficient and rate limiting for fast inactivation in sodium channels. *J. Gen. Physiol.* 142:101–112. <http://dx.doi.org/10.1085/jgp.201310998>
- Chanda, B., and F. Bezanilla. 2002. Tracking voltage-dependent conformational changes in skeletal muscle sodium channel during activation. *J. Gen. Physiol.* 120:629–645. <http://dx.doi.org/10.1085/jgp.20028679>
- Chanda, B., and M.K. Mathew. 1999. Functional reconstitution of bacterially expressed human potassium channels in proteoliposomes: membrane potential measurements with JC-1 to assay ion channel activity. *Biochim. Biophys. Acta.* 1416:92–100. [http://dx.doi.org/10.1016/S0005-2736\(98\)00217-X](http://dx.doi.org/10.1016/S0005-2736(98)00217-X)
- Chanda, B., O.K. Asamoah, and F. Bezanilla. 2004. Coupling interactions between voltage sensors of the sodium channel as revealed by site-specific measurements. *J. Gen. Physiol.* 123:217–230. <http://dx.doi.org/10.1085/jgp.200308971>
- Chanda, B., O.K. Asamoah, R. Blunck, B. Roux, and F. Bezanilla. 2005a. Gating charge displacement in voltage-gated ion channels involves limited transmembrane movement. *Nature.* 436:852–856. <http://dx.doi.org/10.1038/nature03888>
- Chanda, B., R. Blunck, L.C. Faria, F.E. Schweizer, I. Mody, and F. Bezanilla. 2005b. A hybrid approach to measuring electrical activity in genetically specified neurons. *Nat. Neurosci.* 8:1619–1626. <http://dx.doi.org/10.1038/nn1558>
- Chowdhury, S., and B. Chanda. 2012. Estimating the voltage-dependent free energy change of ion channels using the median voltage for activation. *J. Gen. Physiol.* 139:3–17. <http://dx.doi.org/10.1085/jgp.201110722>
- Chowdhury, S., and B. Chanda. 2013. Free-energy relationships in ion channels activated by voltage and ligand. *J. Gen. Physiol.* 141:11–28. <http://dx.doi.org/10.1085/jgp.201210860>
- Goldschen-Ohm, M.P., D.L. Capes, K.M. Oelstrom, and B. Chanda. 2013. Multiple pore conformations driven by asynchronous movements of voltage sensors in a eukaryotic sodium channel. *Nat. Commun.* 4:1350. <http://dx.doi.org/10.1038/ncomms2356>
- Miller, C. 2012. Model-free free energy for voltage-gated channels. *J. Gen. Physiol.* 139:1–2. <http://dx.doi.org/10.1085/jgp.201110745>
- Muroi, Y., and B. Chanda. 2009. Local anesthetics disrupt energetic coupling between the voltage-sensing segments of a sodium channel. *J. Gen. Physiol.* 133:1–15. <http://dx.doi.org/10.1085/jgp.200810103>
- Muroi, Y., M. Arcisio-Miranda, S. Chowdhury, and B. Chanda. 2010. Molecular determinants of coupling between the domain III voltage sensor and pore of a sodium channel. *Nat. Struct. Mol. Biol.* 17:230–237. <http://dx.doi.org/10.1038/nsmb.1749>
- Sigg, D. 2013. A linkage analysis toolkit for studying allosteric networks in ion channels. *J. Gen. Physiol.* 141:29–60. <http://dx.doi.org/10.1085/jgp.201210859>
- Wyman, J. 1967. Allosteric linkage. *J. Am. Chem. Soc.* 89:2202–2218. <http://dx.doi.org/10.1021/ja00985a037>