

## Remembering Bob Rodieck: 1937–2003

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In this special issue of *Visual Neuroscience*, we present a series of papers to honor the life and career of Robert William Rodieck, who passed away at his home in Seattle on September 30, 2003. Rodieck held the E.K. Bishop Professorship in Ophthalmology at the University of Washington Medical Center from 1978–1997. Known to everyone as “Bob,” he leaves behind an intellectual legacy often admired by his colleagues and friends for its scope, intensity, and empathy for what was beautiful in the object of his studies.

Mathew Alpern once wrote of the paradox of William Rushton that he inspired us to follow not his example, but his subject, in making our work the best we can with the abilities we have (Alpern, 1983). In many ways, the same Rushton paradox applies just as aptly to Bob Rodieck. It is perhaps not coincidental that in private conversation Bob often referred to Rushton as his most influential mentor. Both men demonstrated a demand for the strictly empirical and a love for fundamental measurement beyond what had been accomplished in their respective disciplines. Yet, this rigidity was often blended with a buoyant flair and obvious penchant for the dramatic. From Bob’s perspective, science was fun because of the personalities. He had little tolerance for anything or anyone he deemed categorically unexciting. At a 1992 ARVO symposium on primate visual pathways, as he closed in on the years of his retirement, Bob showed a slide of one of the first bistratified ganglion cells to be filled by intracellular injection. In typical Rodieck fashion, he leaned in close to the microscope and breathed, rather than spoke (which was his style), that *this* ganglion cell and not the more prominent and often cited P cell was responsible for color coding (see Rodieck, 1991a). The auditorium was hot in those last of the Sarasota days for ARVO, and it was not clear that anyone was paying much attention. Nevertheless, after the symposium a gaggle of graduate students who were studying color vision (myself included) surrounded Bob and pressed him to explain himself. He did, then patiently asked each one of us about our interests and handed down his opinion (not always positive) of each. Dramatic indeed, definitely unnecessary, but his high-

minded attention to us on that day was exemplary of his love of the debate and of explaining his views to anyone who cared to listen, regardless of title or accomplishment.

Rodieck was drawn early in his career to Rushton’s exuberance, lofty intellect, and unabashed verbal acumen. The latter was often applied in the public forum not so much to embarrass a colleague, but to affirm his own pedigree and sense of irony. Both men had a clear appreciation for the physical sciences (Rodieck had graduated in engineering from MIT in 1958). Both attempted to marry biology with rigorous mathematical analysis. In the middle 1970s, at the University of Sydney where he held the position of Reader, Rodieck teamed with Rushton to attempt a quantitative assessment of how rod and cone signals combine to limit receptive-field sensitivity (Rodieck & Rushton, 1976a,b). With both men, an innate sense that something yet more fundamental lies just beyond the next experiment drove their efforts to reduce the complex to a simple set of observations and an elegant expression of completeness. That the empirical data sometimes did not quite support what in Bob’s mind was an obvious, simple truth never seemed to bother him. Bob loved a beautiful idea and was a master of the “thought experiment”. His ideas flowed in conversation, letters, and e-mails, always exhorting us to follow not *him*, but the *subject* he so loved.

At the time he teamed with Rushton, Bob had finished over 10 years of fundamental work measuring the properties of ganglion cell receptive-field structure (e.g. Bishop & Rodieck, 1965; Rodieck & Stone, 1965a,b). The crux of these experiments led him to propose the difference-of-Gaussians description of center-surround organization (Rodieck, 1965). To this day, this simple mathematical construct remains an important contribution to our understanding of information flow in the retina and early visual system. Perhaps more importantly, Rodieck spent much of his time and energy in the years following these empirical studies devoted to bringing together the current state of knowledge of the retina into his classic and powerful synthesis, *The Vertebrate Retina: Principles of Structure and Function* (1973). This single volume, perhaps more than any other public contribution (including his last, *The First Steps in Seeing*, 1998), forever cemented Rodieck’s name with any future attempts at an analytical, integrative, and thoughtful homage to retinal architecture and physiology.

In his formal communications, whether paper, book, or diagram, Bob paid reverence to the beauty inherent to simplicity. This trait he attributed to the time spent during his teenage years living

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in occupied Japan. Rodieck's father was a career military officer assigned to head an American base in Nagoya shortly after World War II. There were persistent rumors that Rodieck rubbed elbows with General McArthur himself while in Japan, but in our conversations in Seattle during the preparation of *First Steps*, I could never quite get to the factual basis, if any, for those rumors. It could be that too many of these conversations took place during cocktail hour, when Bob and Babs (his wife and traveling companion of 25 years) would open up a bottle of champagne in front of the open stone fireplace in their log home and share the events of the day. It could be that Bob had no real desire to address something he felt was completely irrelevant. Bob loved to talk, indeed to hold court while *he* talked, but he focused almost exclusively on the here and now. The purpose of the ongoing debate, his great and perpetual conversation, was to reach understanding and to communicate his understanding of the topic at hand in its simplest terms. To him, the engagement was occurring now, in the present, for the experience of the participants. These conversations could be exhausting, but for the willing mind, the education in dialogue was worth the fatigue.

Perhaps this sense of engagement is at the root of Bob's expansive influence. By the standards of today's biomedical institution, his career publication record appears modest: 33 primary publications punctuated by a handful of review articles and chapters. Nor is the field of visual neuroscience teeming with his former students and postdoctoral fellows, as it is with so many of his contemporaries. Yet, one cannot deny his singular influence in creating the marriage we, as visual neuroscientists, now enjoy between quantitative anatomy and physiology. His studies of the morphology and projections of ganglion cells in the primate retina are accented by four highly cited papers that anteceded our emerging appreciation for the diversity of parallel visual pathways (Dreher et al., 1977; Rodieck et al., 1985; Watanabe & Rodieck, 1989; Rodieck & Watanabe, 1993). In the early and middle 1990s, while working on *First Steps*, Bob was at the thick of this dialogue as he perused the ARVO meetings. He challenged his younger colleagues to think more globally, to seek the simplest explanation, and above all, to do the right experiment. He flattered so many of us in those later years of his career by his attention to our work and his quick grasp and appreciation of its details. We felt so not because of his stature in terms of his publications or funding level, or because of the prestige of his laboratory. Rather, we felt honored because Rodieck was *Rodieck*, and he transcended most of the typical measures of academic success to become someone much larger. Bob took the time to talk to us, to participate in the emerging debate, and to press us to reach a better understanding of our own pursuits.

Enigmatic, obstinate, at times too forceful with his opinions, Bob was not without his demons. Paradoxically, perhaps at no other time were these as apparent as when he was at his best, during the years preparing *The First Steps in Seeing*. With over 800 illustrations, nearly all of which Bob helped prepare with his long-time assistant Toni Haun, *First Steps* is a graphical, if not outright aesthetic, *tour de force*. There can be no doubt of its far-reaching utility as an educational tool. The book's publishers, Sinauer Associates, Inc., have already translated the book into French and have been working hard on a Japanese translation for some time now. Having nurtured for so long a fascination with all that is Japanese (he loved watching Sumo wrestling), Bob was thrilled to learn of this effort ("What a hoot!" were his words in an e-mail to me). Bob felt strongly that he did not want *First Steps* to evolve simply into an updated edition of *The Vertebrate Retina*, though many of his colleagues encouraged him to do just that. In

fact, in his earliest correspondence about *First Steps*, Bob wrestled with the advantages of an encyclopedic compilation of all that had changed in the retinal field since 1973; he even began referring to his new book as "TVR2". However, in the end he realized he wanted desperately to try something different with this book. In an e-mail to me from January 1997, Bob wrote:

*This book is not intended to be a critical review of the literature. That is not what the reader wants or needs for their 'first steps' in the mechanistic underpinnings of seeing. I keep in mind how I would describe seeing to a child or an uninformed adult. In this sense I want to hide the citations in the Thread portion, simply because they distract from the conceptual premise.*

In this excerpt, Bob was responding to my criticism that the drafts of *First Steps* did not contain appropriate citations to published work. I argued that since the book was intended to educate, fact-hungry readers eager to look up primary references on their own would find the lack of bibliographic notes annoying. Bob was adamant though, that what he called "The Thread" of the book should read like a story and that details would be given "off-Thread", so to speak. This criticism presaged what many now believe is the greatest flaw of the book, that it reads too much like a poorly annotated story and too little like a biomedical textbook. Yet, there is no denying that Bob succeeded in creating something new with this book, and with it, he once again affirmed his love of the simple and beautiful. He succeeded in expressing himself in his way, and not in how we might prefer.

After the publication of *First Steps*, Bob spent most of his time farming his land on Waldron, one of the smaller of the San Juan Islands lying between Vancouver Island, Canada and the state of Washington. While Bob was most proud of his crops of rye and buckwheat, he was also actively engaged in pursuing a new color metric that he planned to include in a small book about various aspects of color vision. Ironically, while Bob never studied color coding *per se* in his laboratory, he did make one considerable contribution, in the aforementioned linkage between bistratified ganglion cells and color opponency (Rodieck, 1991a). Bob reasoned that by drawing from both ON and OFF bipolar cells, a bistratified ganglion cell could provide the substrate for the red/green or blue/yellow "type II" receptive field described by Hubel and Wiesel and that such cells match more closely the properties of the color channels (see the discussion of this in Calkins and Sterling, 1999). While there is very little to suggest that Bob's idea is correct for red/green color vision (e.g. Dacey et al., 2003), his hypothesis has proven seminal for blue/yellow color vision (Dacey & Lee, 1994; Dacey et al., 2005).

The series of articles in this special issue represent the gamut of Rodieck's contributions to visual neuroscience. Physiological papers highlight Bob's early work in rod and cone contributions to ganglion cell physiology (Rodieck & Rushton, 1976a,b) and his life-long interest in photoreceptor physiology, as evidenced by the extensive detail given the topic in both *The Vertebrate Retina* and *First Steps*. Other articles honor Bob's profound impact on our understanding of the spatial sampling properties of retinal neurons and on receptive-field structure (1991b), including a fresh evaluation of his difference-of-Gaussians model (Rodieck, 1965). Finally, multiple papers pay homage to Bob's keen insight into information flow in parallel visual pathways and how these pathways differ between primate species. The great breadth and variety of the studies presented here represent a fitting tribute from the colleagues and friends of one whose interests and contributions were themselves so expansive and diverse.



William Rushton (left) and Bob Rodieck (right) in Sydney, Australia circa 1975.

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### References

- ALPERN, M. (1983). Some rushton paradoxes seen from the other side of the Atlantic. In *Colour Vision: Physiology and Psychophysics*, ed. MOLLON, J.D. & SHARPE, L.T., pp. 590–596. London: Academic Press.
- BISHOP, P.O. & RODIECK, R.W. (1965). Discharge patterns of cat retinal ganglion cells. In *Proceedings of the Symposium on Sight-Sensory Systems*, ed. NYE, P.W., pp. 116–126. California: California Institute of Technology.
- CALKINS, D.J. & STERLING, P. (1999). Evidence that circuits for spatial and opponent color vision segregate at the first retinal synapse. *Neuron* **24**, 313–321.
- DACEY, D.M. & LEE, B.B. (1994). The 'blue-on' opponent pathway in primate retina originates from a distinct bistratified ganglion cell type. *Nature* **367**, 731–735.
- DACEY, D.M., LIAO, H.W., PETERSON, B.B., ROBINSON, F.R., SMITH, V.C., POKORNY, J., YAU, K.W. & GAMLIN, P.D. (2005). Melanopsin-expressing ganglion cells in primate retina signal colour and irradiance and project to the LGN. *Nature* **433**, 749–754.
- DACEY, D.M., PETERSON, B.B., ROBINSON, F.R. & GAMLIN, P.D. (2003). Fireworks in the primate retina: *In vitro* photodynamics reveals diverse lgn-projecting ganglion cell types. *Neuron* **37**, 15–27.
- DREHER, B., FUKADA, Y. & RODIECK, R.W. (1977). Identification, classification and anatomical segregation of cells with X-like and Y-like properties in the lateral geniculate nucleus of Old World primates. *Journal of Physiology* **258**, 433–452.
- DREHER, B. & STONE, J. (2004). Robert William Rodieck, Neuroscientist. *Proceedings of the Australian Neuroscience Society*, Vol. 15, pp. X–XI.
- RODIECK, R.W. (1965). Quantitative analysis of cat retinal ganglion cell response to visual stimuli. *Vision Research* **5**, 583–601.
- RODIECK, R.W. (1973). *The Vertebrate Retina: Principles of Structure and Function*. W. H. Freeman, San Francisco.
- RODIECK, R.W. (1998). *The First Steps in Seeing*. Sunderland, Massachusetts: Sinauer Associates, Inc.
- RODIECK, R.W. (1991a). The density recovery profile: A method for the analysis of points in the plane applicable to retinal studies. *Visual Neuroscience* **6**, 95–111.
- RODIECK, R.W. (1991b). "Which Cells Code for Color?" In *From Pigments to Perception: Advances in Understanding Visual Processes*, ed. VALVERG, A. & LEE, B.B., pp. 83–93. New York: Plenum Press.
- RODIECK, R.W., BINMOELLER, K.F. & DINEEN, J. (1985). Parasol and midget ganglion cells of the human retina. *Journal of Comparative Neurology* **233**, 115–32.
- RODIECK, R.W. & RUSHTON, W.A.H. (1976a). Isolation of rod and cone contributions to the cat ganglion cells by a method of light exchange. *Journal of Physiology* **254**, 759–773.
- RODIECK, R.W. & RUSHTON, W.A.H. (1976b). Cancellation of rod signals by cones, and cone signals by rods in the cat retina. *Journal of Physiology* **254**, 775–785.
- RODIECK, R.W. & STONE, J. (1965a). Response of cat retinal ganglion cells to moving visual patterns. *Journal of Neurophysiology* **28**, 819–832.
- RODIECK, R.W. & STONE, J. (1965b). Analysis of receptive fields of cat retinal ganglion cells. *Journal of Neurophysiology* **28**, 833–849.
- RODIECK, R.W. & WATANABE, M. (1993). Survey of the morphology of macaque retinal ganglion cells that project to the pretectum, superior colliculus, and parvocellular laminae of the lateral geniculate nucleus. *Journal of Comparative Neurology* **338**, 289–303.
- WATANABE, M. & RODIECK, R.W. (1989). Parasol and midget ganglion cells of the primate retina. *Journal of Comparative Neurology* **289**, 434–454.

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