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In Memoriam

# Andrés Carrasco (1946–2014)

Professor Andrés Eduardo Carrasco died on May 10, 2014 after a short illness. He was only 67 years old, still with great vitality and passion for science. Andrés was trained as a Medical Doctor, graduating from the School of Medicine, University of Buenos Aires in 1971. He then taught physiology, cell biology and embryology at UBA until 1981. Andrés then moved to the Biocenter of the University of Basel, Switzerland, where he made his first major discovery as a Postdoctoral Fellow in the laboratory of Eddy de Robertis. Together with Bill McGinnis in Walter Gehring's lab, Andrés cloned and sequenced the first vertebrate homeobox gene of the Hox/homeotic type, the eponymous *A*ndrés *C*arrasco 1 (AC1), now known as *Hoxc6* (Carrasco et al., 1984. Cell 37, 409–414). This provided the best evidence that genes involved in the patterning of the anterior–posterior axis of insect embryos were conserved in vertebrates. This was a seminal discovery in Developmental Biology as homeobox genes of the Hox type represented the first development-controlling gene identified in vertebrates.

In 1984, Andrés moved to Indiana University as a Senior Research Fellow with George Malacinski. It was here that Andrés performed the first in situ hybridizations in *Xenopus laevis* embryos, localizing *Hoxc6* in late gastrula, neurula and tadpole embryos. Although his methodology was superseded by the faster and more generally applicable whole mount in situ hybridization of Harland and colleagues, Andrés was the first to show the spatial distribution of a Hox gene with sufficient sensitivity to detect a low abundance mRNA in amphibian embryos (Carrasco and Malacinski, 1987. Developmental Biology 121, 69–81). By 1988, antisense oligonucleotide technology had become a promising approach to block the function of specific mRNAs. Andrés moved to Larry Etkin's laboratory at the University of Texas in Houston to explore the use of this technology to destroy specific maternal mRNAs using in vitro matured oocytes. Disappointingly, the main result of these studies was to show that a highly localized maternal mRNA (*xlgv7*) was apparently dispensable for normal development (Kloc et al., 1989. Development 107, 899–907).

In 1990, Andrés returned to the city he loved, Buenos Aires, aiming to build developmental biology in Argentina. He secured a position at the National Scientific and Technical Research Council (CONICET) at his alma mater. Despite the difficult financial climate in Argentina, Andrés and his colleagues published a succession of high quality papers over the next 24 years, first on Hox genes and their regulation by retinoic acid, then extending their interest towards the involvement of sonic hedgehog, retinoic acid and presenilin in neurogenesis, and later on the role of Notch signaling during early embryogenesis. In addition to his scientific research, Andrés served as the director of CONICET from 2000 to 2001 (a most difficult time economically in Argentina) and as Under-secretary for Scientific and Technological Innovation of the Ministry of National Defense. Andres was also a long time member of the Society for Developmental Biology.

I first met Andrés at an International *Xenopus* meeting in 1996. His cloning of AC1 inspired me as a Ph.D. student and how to determine its function, in vivo, was the topic of my advancement to candidacy proposal, so I was happy to finally meet him. Andrés and I talked and argued for many hours about the merits of various approaches to science, politics, personal philosophy, fatherhood, etc. One of Andrés's most notable qualities was his passion and willingness to debate a topic almost endlessly, particularly with respect to its inherent morality. He was a person who would rather die than compromise fundamental principles. Over the years, Andrés became like an elder brother to me and we often discussed projects and experiments with each other and our respective students and postdocs. I and many of the other postdocs from the early years in Eddy de Robertis's lab jokingly called him “Il Padrino” – the godfather of the De Robertis postdocs. This amused Andrés greatly because he and Eddy had a difficult relationship at best.

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In recent years, Andrés found a new scientific interest. Moved by the plight of agricultural workers in areas of intensive cultivation of genetically modified crops (GMO), and particularly by the passion of the “Madres de Ituzaingo” (a grass roots organization devoted to protecting children from the effects of agricultural pesticides), he undertook to study the effects of the commonly used herbicide, glyphosate, on vertebrate development. Using his favorite model, *X. laevis,* Andrés and his colleagues discovered that glyphosate, or glyphosate based herbicide (GBH) formulations caused a variety of craniofacial and neural tube defects as well as loss of primary neurons. Remarkably, these defects appeared to be related to alterations in retinoic acid signaling because the phenotypes induced by high doses of GBH used in these experiments could be completely rescued by co-application of a retinoic acid antagonist (Paganelli et al., 2010. Chemical Research in Toxicology 23, 1586–1595). Due to his great passion for social fairness and deep sense of moral outrage, Andrés released these results of his studies publically prior to publication, reasoning that matters of public health demanded immediate disclosure. This led to the filing of a lawsuit against the Argentine government seeking an injunction to prohibit the use of GBH. As GMO agriculture is a multi-billion dollar annual enterprise in Argentina (and elsewhere), his results first met with controversy and then attempted censure from the Minister of Science, followed by sustained attempts to discredit the work by scientists sympathetic to Monsanto after publication of the Paganelli et al. (2010) paper. There were violent demonstrations in support of the use of GBH in agriculture in Argentina on some occasions when Andrés spoke on the topic, together with anonymous threats against him.

Undaunted, Andrés was delighted to battle against big agrobusiness, particularly Monsanto (the major producer of glyphosate), and viewed himself as a modern day Che Guevara fighting to protect the common people from overwhelming economic forces acting for profit at the expense of public health. A very informative article by the journalist Dario Aranda can be found at http://www.lavaca.org/notas/andres-carrasco-cientifico-y-militante-gracias/. Andrés spoke throughout Latin America and around the world about his findings and was a passionate advocate for the banning of all GMO crops.

When I last visited him in Buenos Aires in November 2013, Andrés had just returned from Mexico where he participated in the Permanent People's Tribunal, discussing the dangers of GMO agriculture in Mexico. He proudly showed me a letter from Subcomandante Marcos of the Zapatista Army of National Liberation, inviting Andrés to brief that organization on issues related to GMO agriculture, particularly as they related to indigenous small farmers in Mexico whose crops were being displaced by GMO corn. Ironically, it was shortly before leaving to visit Marcos in January 2014 that Andrés first fell ill and an infection acquired in a Mexican hospital nearly killed him. He later realized that it was perhaps not prudent to have undertaken such a trip, but Andrés's commitment was such that he was able to risk his life for a cause. Throughout his illness, Andrés maintained his sense of humor, his moral force and his passion for the fight against GMO crops. He discussed treatment options with his doctors in the same intense way that he debated the merits of each experiment in the lab (particularly those he did not agree with). He died in Buenos Aires surrounded by family and loved ones. With Andrés's passing, the *Xenopus* community has lost a careful and insightful investigator who made numerous important contributions to the field. Perhaps more importantly, the world has lost a strong voice for protecting indigenous crops and communities against the effects of GMO agriculture. Andrés will be missed, but his spirit and passion will continue to light the way for those whose lives he touched. His former laboratory in the Institute of Cellular and Molecular Neurosciences at the Faculty of Medicine at the University of Buenos Aires has been renamed to the "Laboratorio de Embriología Molecular "Prof. Dr. Andrés E. Carrasco" in his honor.

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