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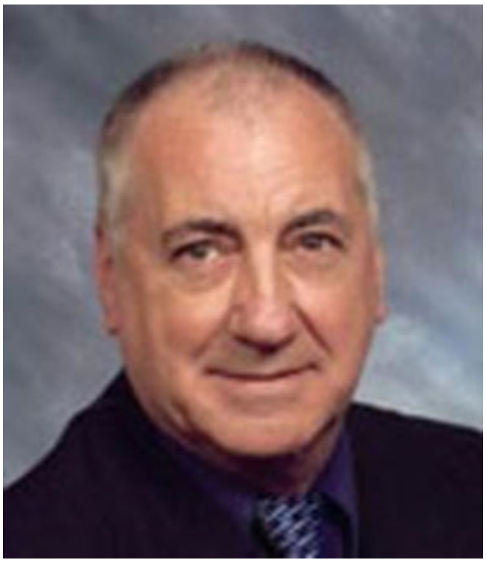
Recipient of the 2019 IETS Pioneer Award: Dr Barry Bavister*

Dr Barry Bavister is the recipient of the International Embryo Technology Society (IETS) Pioneer Award. Barry is a well-known scientist in reproductive biology and pioneered human *in vitro* fertilisation in collaboration with Robert Edwards and Patrick Steptoe. Dr Robert Edwards received the 2010 Nobel Prize in Physiology and Medicine for this remarkable achievement. Dr Bavister's graduate research with Dr Edwards discovered a key role for pH, showing how higher rates of fertilisation could be obtained by simply increasing the alkalinity of the culture medium. His research was fundamental for the first successful *in vitro* fertilisation (IVF), which led to the birth of Louise Brown, the world's first test-tube baby. 40 years after the first IVF baby, more than 8 million babies have been born.

Barry Bavister was born in 1943 and currently resides in New Orleans, Louisiana. He obtained his BA in physiology from the University of Cambridge in 1967 and a PhD from the Marshall Laboratory of Reproductive Sciences at the University of Cambridge in 1972 under Professor C. R. Austin. He received postdoctoral training with Professor Ryuzo Yanagimachi at the University of Hawaii. Barry was a professor at University of University of Wisconsin-Madison and the Wisconsin Regional Primate Research Center as an Assistant Professor for over 20 years. He became the Freeport-McMoRan Endowed Chair of Conservation and Reproductive Biology at the University of New Orleans in 2000.

Fertilisation of the human egg achieved at last

Barry Bavister was Austin's first graduate student (1967–1972), trying to resolve the factors influencing the capacitation of hamster spermatozoa *in vitro*. In 1969, Bavister discovered the key role of pH in fertilisation (Bavister 1969), showing how higher rates of fertilisation could be obtained by simply increasing the alkalinity of the media (Bavister 1969). Robert Edwards shared the laboratory with Austin and recruited Barry to his project. The culture medium that Barry had developed showed that human eggs and sperm could be successfully inseminated *in vitro*. In 1968, Edwards, Bavister and Steptoe, submitted the manuscript to *Nature* (Edwards *et al*. 1969). The *Nature* paper makes modest claims since only 18 of 56 eggs were assigned to the experimental group for *in vitro* fertilisation and only two embryos with two pronuclei exhibited fertilisation (Johnson 2011).



According to Edwards (Edwards and Steptoe 1980) Jean Purdy, a British nurse who was Edwards' embryologist, drove to Edgeware General Hospital to collect:

> the last piece of ovarian tissue that I was to obtain from the Edgware General Hospital. It yielded me 12 human eggs. Those eggs were soon ripening in mixtures of culture medium I had used over many years to which some of Barry [Bavister]'s fluid had been added. Thirty-six hours later we judged that they were ready for fertilization.

Ten hours later, Edwards and Bavister returned to the laboratory late at night:

> A spermatozoon was just passing into the first egg … An hour later we looked at the second egg. Yes, there it was, the earliest stages of fertilization. A spermatozoon had entered the egg without any doubt – we had done it … We examined other eggs and found more and more evidence. Some ova were in the early stages of fertilization with the sperm tails following the sperm heads into the depths of the egg; others were even more advanced with two nuclei – one from the sperm and one from the egg – as each gamete donated its genetic component to the embryo.

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After this discovery, Edwards was able to fertilise human ova *in vitro* routinely, leading to the first IVF birth – Louise Brown in 1978. Clearly, Barry Bavister at the age of 25 was instrumental in the development of human IVF. The Nobel Prize in Physiology of Medicine 2010 was awarded to Robert G. Edwards 'for the development of *in vitro* fertilization and we recognize Barry Bavister as being one of the pioneers of this technology'.

First monkey IVF

Barry Bavister developed the first reliable procedures for IVF in monkeys in 1979, and the first genetically documented IVF monkey 'Petri' was born in 1983. Petri, aptly named for the plastic dish in which he was conceived, was the world's first test-tube rhesus monkey. Arriving nearly five years after the birth of Louise Brown, the first human born through the technique of *in vitro* fertilisation, Petri was praised as an important primate research model to supply basic information on IVF and embryogenesis. 'Petri's unremarkable existence should be a source of comfort for the hundreds of thousands of people whose lives began through IVF', said Bavister. 'The primary thing is his normality. It allays fears that somewhere down the road there would be problems,' he said, referencing concerns that somehow humans conceived through IVF, while seemingly normal at birth, might face developmental or reproductive problems later in life.

Petri, and two other male rhesus macaques conceived through IVF live at the Wisconsin primate centre. The monkeys have matured through puberty and sired healthy offspring through traditional means. Although humans born through *in vitro* fertilisation arrived on the scene years before the primate model, the compressed lifespans of non-human primates make it possible to study mileposts of development and reproduction that IVF humans have yet to encounter. The average lifespan of rhesus macaques is 26, but those in captivity may live to be 40.

'Monkeys mature so much faster than humans,' said Bavister. In addition, rhesus macaques and humans are nearly the same at the genetic level, sharing a genome that is more than 90 percent identical. The IVF rhesus monkey model in the culture dish is excellent in terms of our understanding of the first phases of primate embryo development. It also is the best model for human perinatal physiology. Petri and his two test-tube companions at the Wisconsin primate centre have successfully reproduced and alleviate concerns about the future reproductive success of humans conceived through IVF.

Barry's scientific contributions in early embryo development have been instrumental for successfully culturing eggs, sperm and embryos in several mammalian species. His laboratory showed that changes in intracellular pH are regulators of early mammalian embryo development; demonstrated that specific energy substrates and amino acids regulate embryo development, which provided the basis for the formulation of sequential culture media; provided the first evidence that timing of embryo development is critically important for viability; and showed that mitochondrial distribution and/or activity changes during fertilisation, and that these changes are perturbed in embryos that have poor or no developmental competence – artificially perturbing pHi produces similar developmental and subcellular changes. His work promises to provide new insights into the relationships between embryos and their culture environment, leading to improved culture media formulations.

Barry has authored or co-authored 251 refereed journal articles, plus 27 book chapters and proceedings of scientific meetings, and edited 3 books, all on the topics of gamete biology, *in vitro* fertilisation and embryo development. He has over 13 059 citations. He has served on numerous grant review panels for the National Institutes of Health and the US Department of Agriculture. His research was continuously funded by the US government from 1978–2011 with a total award amount of over US$9 million.

Barry has been an inspiration for all of us. His enthusiasm for science is also evident in the classroom. Barry is a teacher for undergraduate students, graduate students, professors and researchers. Barry is quick-witted, passionate and engaging. For those that do not know him, he is happily retired and loves reading, travelling, boating, snorkelling and scuba diving, and if you have a beer with him he will tell you stories about his incredible journey as a scientist.

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