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RETROSPECTIVE

Robert G. Edwards (1925–2013)

The work of a pioneer of in vitro fertilization led to the first "test-tube baby" and changed the field of human reproductive biology.

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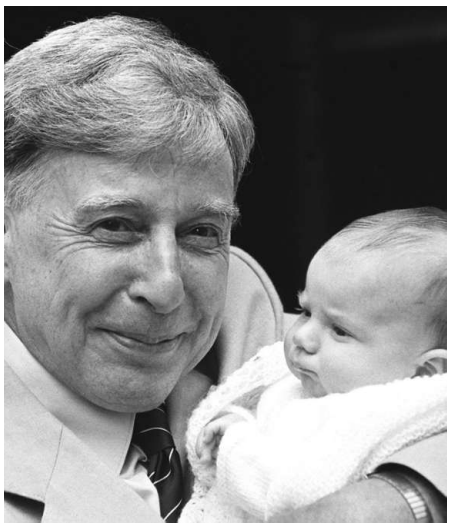
Robert G. Edwards, who with his colleagues Patrick Steptoe and Jean Purdy enabled the birth of the first "test tube" baby, died on 10 April at his home near Cambridge University in England. He was 87. In 2010, he was awarded the Nobel Prize in Physiology or Medicine for the team's work, ushering in the era of in vitro fertilization (IVF), which allows infertile couples to have their own biological children. The societal impact of this revolution in human reproduction has been enormous. An estimated 5 million babies have been born as the result of assisted reproductive technologies, a number that will doubtless increase as a result of delayed childbearing. Sadly, due to failing health and dementia, Edwards was unable to attend the Nobel award ceremony, and it is unlikely that he even knew of this great recognition. His wife, Ruth Fowler Edwards (they met as graduate students), and former trainee, Martin H. Johnson, addressed the audience on his behalf, a cruel irony given the unbridled passion with which he spoke and wrote about his work on human reproduction.

Robert Geoffrey Edwards was born in 1925 in Yorkshire, England. He attended the University of Wales and then earned a Ph.D. in physiology from the University of Edinburgh in 1955. He joined the University of Cambridge faculty in 1963 where he remained for the rest of his career. The notion that human IVF was possible first occurred to Edwards during his graduate work. He realized he could do nothing to help infertile couples until human oocytes (egg cells) were fertilized in vitro. In 1965, after two disappointing years, he coaxed ovarian tissue that had been removed from patients to produce several oocytes. As he described in a *Nature Medicine* article in 2001, after receiving the prestigious Albert Lasker Clinical Medical Research Award, "I waited for 25 hours—and joy unbounding! A beautiful diakinesis, superb chromatids…Now a definite future existed for human IVF."

Retrieving tissue from a woman's ovaries required minimal surgery. To this end, Edwards partnered with Patrick Steptoe,



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an obstetrician and gynecologist who was an expert in the technique of laparoscopy. They collaborated for ~20 years, until Steptoe's death in 1988. Against seemingly insurmountable odds—little human material available for research, a modest laboratory, no government funding, as well as strong disapproval from colleagues and the public—Edwards worked passionately and methodically over decades to achieve the dream he had as a graduate student. His publications during the 1960s and 70s lay out the blueprint of his plan for bringing human IVF to fruition. (He also described prenatal genetic diagnosis, stem cells, and cloning.) The initial attempts were frustrating, as egg cells that were matured and fertilized in vitro failed to initiate pregnancy when transferred back into the uterus. Edwards concluded that for IVF to work, eggs that matured during the natural menstrual cycle had to be collected from patients. This key insight, among others, led to the birth of Louise Brown, the first test-tube baby, on 26 July 1978.

Although Edwards and a lawyer, David Sharpe, outlined in a 1971 *Nature* article the difficult social and ethical issues that human embryo research entailed, major arguments in the press and criticism from colleagues formed a constant backdrop to his work with Steptoe. As Edwards wrote in the 2001 article, "Ethicists decried us, forecasting abnormal babies, misleading the infertile and misrepresenting our work as really acquiring human embryos for research." On one particular day, Edwards issued eight libel actions in the High Court of London. "I won them all, but the work and worry restricted research for several years."

After Edwards and Steptoe achieved their goal in 1978, they were told that government funding for their work would not be forthcoming. Again, the team entered uncharted waters, but emerged years later once they garnered private support, and founded the Bourn Hall Clinic in Cambridge for training gynecologists and biologists from around the world. Where did his colossal motivation come from? One source was Edwards's passion for developmental biology. He was also deeply moved by the plight of infertile couples who ultimately made IVF possible by bravely participating in the work before there was any evidence it would succeed. As he and others learned to recapitulate fertilization and the initial steps of embryo development in vitro using animal models, he became increasingly convinced that these technologies could be translated to humans.

Despite the importance of studying human reproductive biology, proven by the work of Edwards and others, many aspects of this research remain challenging. In the United States, the Dickey-Wicker Amendment, passed every year since 1996, prohibits the use of federal funds for research that creates or destroys human embryos. Accordingly, the derivation of human stem cells from embryos, which was first reported by James Thomson in 1998, was accomplished with nonfederal funds as must be the case for all such stem cell lines derived in the United States.

Through Edwards's energy, determination, and rigorous study, IVF is now considered common medical practice. Unfortunately, societal and governmental views toward studying human development have not evolved apace. What would Edwards, one of the most provocative medical researchers and humanists in modern history, think of this situation? As he wrote in the 1971 article, "When scientists clearly foresee potential conflicts with existing rules of society arising from their work, paradoxically both human progress and scientific freedom may hang on their activism in arenas generally regarded as social or political."

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