Robert Geoffrey Edwards (1925-2013) [1]

By: Philbrick, Samuel Keywords: Biography [2] Fertilization [3]

Robert Geoffrey Edwards worked with Patrick Christopher Steptoe to develop *in-vitro* fertilization [4] (IVF) techniques during the 1960s and 1970s in the United Kingdom. In 1978, Louise Brown, sometimes called the world's first test-tube baby [5], was born as a result of Edwards and Steptoe's IVF techniques, and since then more than four million children have been born using IVF techniques. Publicity and controversy accompanied Edwards and Steptoe's work, as religious institutions criticized the morality of the IVF procedure. Edwards received numerous awards for his work, including the 2010 Nobel Prize in Physiology or Medicine [6].

The son of Margaret and Samuel Edwards, Edwards was born on 27 September 1925 in Leeds, England, and grew up in Manchester. He graduated from Manchester Central High School, but World War II delayed further academic pursuits. Edwards served in the British army in Palestine, Jordan, Egypt, and Iraq from 1944 to 1948.

After returning to England in 1949, Edwards entered the University of Wales in Cardiff, Wales, and he studied for a degree in agriculture. Before long, however, he switched his focus to zoology, and in 1951 he earned an undergraduate degree in that subject. His subsequent studies under Alan Beatty at the Institute of Animal Genetics [7] at Edinburgh University [8] in Edinburgh, Scotland inluenced the rest of Edwards's career. There he worked on altering chromosomal complements, the whole set of chromosomes in a species, in mouse [9] embryos. He also studied fertilization [4], embryos, artificial insemination [10], infertility [11], and reproductive physiology.

However, studying mouse [9] embryos proved an inconvenient task. The female mice ovulated at approximately midnight, which forced him to spend many hours in the lab in the middle of the night. He worked with this schedule for years until another student named Alan Gates began taking the graveyard shift. Edwards and another PhD student, who later married him—Ruth Fowler, found a way to avoid the insomnia-inducing inconvenience of gamete gathering. Developing what would later be termed the Fowler-Edwards method, the pair found that by giving the mice doses of various hormones [12] they could control not only how many eggs would mature, but also the time of ovulation [13].

Edwards earned his PhD in physiology in 1957 at Edinburgh University [8]. He went to Pasadena, California, and spent year working with Albert Tyler [14] at the California Institute of Technology [15]. Edwards then returned to England to take a five-year position at the National Institute of Medical Research, where his research focused on biomedicine.

At the National Institute of Medical Research in London, he developed an idea that he could take human eggs and fertilize them *in vitro* [16]. He later wrote that even then he had hoped to transfer the resulting embryos into infertile women to help them conceive. Most gynecologists were unwilling to help him get access to eggs; however, Molly Rose, an obstetrician, occasionally sent him sections of human ovaries.

Previous research had indicated that oocytes removed from their follicles would mature in twelve hours. Edwards experimented with numerous animal oocytes and found the estimate correct. However, human oocytes did not mature in this time frame, and he spent two years of research without producing any mature human eggs *in vitro* [16]. Eventually, he decided to try waiting for a longer period of time for the eggs to mature. He found that human eggs take twenty-five hours to begin maturing, and thirty-seven hours before they are ready to be fertilized. However, he found obtaining human eggs to be difficult, so he put aside this research for a year.

In 1962 Edwards assumed a teaching position at the University of Glasgow [17] in Glasgow, Scotland, and researched mammalian stem cells [18]. He remained for just one year before moving to University of Cambridge in Cambridge, England, where he worked until 1989.

There Edwards worked with PhD student Richard Gardner conducting experiments that would enable pre-implantation [19] genetic diagnosis (PGD). Edwards also resumed his research on oocytes and *in vitro* [16] fertilization [4]. In 1968 he partnered with Patrick Christopher Steptoe. Steptoe was a gynecologist, and an expert in laparoscopy, a minimally invasive procedure that offered a minimally invasive way to access patients' ovaries. Edwards needed eggs that had grown to maturity *in vivo* [20] because eggs that matured *in vitro* [16], even if they could be successfully fertilized, died soon after embryogenesis [21]. Edwards later recalled that he and Steptoe had agreed to work as equals, to stop if their work appeared to harm patients or children, and

not to stop because of political and religious naysayers.

In 1969 Edwards and Steptoe found that sperm [22] fresh from ejaculate could fertilize a mature egg [23] *in vitro* [16], which surprised them, as previous theories had held that substances from a woman's reproductive tract was also necessary for fertilization [4]. Anticipating the ethical controversy his research would generate, Edwards co-published a paper that addressed ethics and IVF, "Social Values and Research in Human Embryology" in *Nature* with lawyer David Sharpe. However, in the same year the British Medical Council also rejected an application put forward by Edwards and Steptoe for IVF research funding.

However, Oldham and District General Hospital in Oldham, England and the University of Cambridge sponsored their efforts, giving ethical consent and funding. In 1972, Steptoe and Edwards began trying to help infertile couples conceive. At first, they gave women doses of hormones [12] to induce ovulation [13], then removed matured eggs via laparoscopy, and fertilized and tried to transfer the eggs. This work was unsuccessful for years. They later realized that the hormones [12] or synthetic hormones [12] that they gave to the patients were interfering with patients' natural menstrual cycles and causing the uteruses to shed their linings right when Edwards and Steptoe needed to implant the embryos. Edwards and Steptoe stopped using hormone therapy [24] altogether, and tracked patients' urine for a rise in luteinizing hormone [25] to find out when patients were ovulating.

On 9 November 1977, Edwards and Steptoe removed an egg [23] from Lesley Brown with laparoscopic surgery. With *in vitro* [16] methods, they successfully fertilized the egg [23] and implanted it. On 26 July 1978, Louise Brown was born and described by many as the world's first "test-tube baby." Edwards and Steptoe stopped their work for two and a half years until they could secure private funding to open the Bourn Hall Clinic [26] in Bourn, UK in 1980.

Steptoe and Edwards published a book, titled *A Matter of Life: The Story of a Medical Breakthrough*, in 1980. Edwards continued his research related to human embryonic stem cells [27] (HESCs) as well, and in 1984 he co-authored "Human Chorionic Gonadotropic Secreted by Preimplantation Embryos Cultured *in vitro* [16]". However, this research proved controversial, and Edwards did not pursue it. Instead, he continued to write about IVF, and in 1993 his edited book, *Preconception and Preimplantation Diagnosis of Human Genetic Disease* was published. A decade later, he co-edited *Modern Assisted Conception*.

As a result of his research, Edwards received numerous awards; in 1988 Queen Elizabeth II granted him the title of Commander of the British Empire (CBE). In 2001 he received the Albert Lasker Basic Medical Research Award [28], and in 2002 he received the Grand Hamdan Award for Clinical Science.

Edwards won the Nobel Prize in Physiology or Medicine [6] in 2010 for helping to develop IVF techniques. Because the award is not given posthumously, Steptoe, who died in 1988 after working with Edwards for 20 years, could not share the award. The Vatican criticized the award, calling it "completely out of order," and stating that without IVF research, there would be no market for human eggs or freezers full of human embryos.

With more than 10,000 babies born at Bourn Hall Clinic [26], and greater than four million babies born worldwide, Edwards influenced scientific research and society. Furthermore, the human embryonic stem cells [27] that he studied were successfully cultured by James Thomson [29] in the US in 1998. Thomson's discoveries helped inspire researchers like Shinya Yamanaka [30] in Japan to further advance the field of human stem cell research. In 2007, Yamanaka showed how to induce human pluripotent stem cells [18] from adult cells, work that contributed to his sharing of the 2012 Nobel Prize in Physiology or Medicine [6]. Edwards died in Cambridge, England, on 10 April 2013.

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Subject

Edwards, R. G. (Robert Geoffrey), 1925-2013 [43] Fertilization in Vitro [44]

Topic

People [45] Reproduction [46]

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