

Ernest Everett Just

Ernest Everett Just was an early twentieth century American experimental embryologist involved in research at the Marine Biological Laboratory (MBL) at Woods Hole, Massachusetts, and the Stazione Zoologica in Naples, Italy. Just was known for simple but elegant experiments that supported the “fertilizing” theory of Frank R. Lillie and served as an antagonist to Jacques Loeb’s work with artificial parthenogenesis. Just’s many experiments with marine invertebrates showed that the egg surface, or ectoplasm, plays an important role in the fertilization and development of eggs.

Just was born in Charleston, South Carolina, on 14 August 1883 to Charles Frazier Just Jr. and Mary Matthew Just. His father died in 1887 and soon after the Just family moved to James Island, off the coast of South Carolina. His early education consisted of attending the small school that his mother founded and directed. Just left James Island at the age of twelve to attend the Colored Normal Industrial Agricultural and Mechanics College at Orangeburg (now South Carolina State College). In 1899 Just graduated with a Licentiate of Instruction, meaning that he was certified to teach in any black school in South Carolina. He was only fifteen years old.

Teaching did not appeal to the teenager so he traveled north, picking up odd jobs along the way until he reached Kimball Union Academy in Meriden, New Hampshire. Just finished a classical course of study in three years, during which time his mother died. The young college graduate was advised by friends and teachers to attend Dartmouth College which he decided to do. At Dartmouth, Just studied biology, history, literature, and the classics. He graduated from Dartmouth in 1907, the only “magna cum laude” in his class, with an AB degree and joined the English faculty at Howard University, Washington, DC in the fall of that same year. He was asked to take over the biology department and teach physiology in 1910, in addition to his English teaching duties. Soon after, Just became the first head of the new Department of Zoology and gave up teaching English courses.

Through a Dartmouth contact, Just communicated with Lillie at the University of Chicago about a post-graduate degree in biology. Lillie directed Just to begin research in 1909 at Woods Hole and to take courses at the University of Chicago. Work at the marine station quickly turned into a research assistantship, working side-by-side with Lillie. All of this was done in addition to maintaining a full-time teaching position at Howard. After obtaining his PhD, Just returned annually to Woods Hole as an independent researcher.

Just focused his interests on marine invertebrate eggs, both in the laboratory and in their natural setting. Because of his tacit knowledge of how marine invertebrates reproduced in oceans and estuaries, Just was able to closely match his laboratory environment to that of the organism’s natural environment. In 1912, Just’s first paper, “The Relation of the First Cleavage Plane to the Entrance Point of the Sperm.” was published in the *Biological Bulletin*. Just showed that eggs of the marine worm (*Nereis*) cleave in different planes depending on the sperm’s point of entry. To Just, the egg’s surface was an important and robust factor in the fertilization process. By showing that sperm had an equal probability of entering the egg at any point on the egg’s surface, and that the direction of cleavage depended on the arbitrary point of entry of sperm, and not some predetermined cleavage plane, Just made a dent in preformationist theory. It was also during this time that he married Ethel Highwarden in 1912 and met Jacques Loeb while Loeb was at the Rockefeller Institute for Medical Research. Similar research interests and Loeb’s stand on social equality made the two embryologists fast, but not longstanding friends. In 1915 Just was the first to receive the Spingarn Medal, presented annually to the African-American who performs the greatest service to his or her race. This was followed by the University of Chicago awarding Just his PhD degree in experimental embryology in 1916.

During 1919 and 1920, Just published four papers in the *Biological Bulletin*, all focusing on his work with the sand dollar *Echinarchnius parma*. In one set of experiments Just measured the elevation of the egg membrane at sperm contact and the time that it took for the membrane to be penetrated by a sperm. He observed that the sperm was pulled into the egg rather than the commonly held view that it actively bored its way into the egg. Just also documented a “wave of instability” that moved from the sperm’s entry point to the opposite side of the egg. Since then, embryologists have proven that such an instability wave is a wave of cortical granule exocytosis that forms the fertilization envelope. Just also saw that the wave was associated with an immediate blocking of any further sperm penetrability of the egg.

In 1920, while continuing to teach at Howard, Just obtained a ten-year research fellowship from Julius Rosenwald through the National Research Council. He wasted no time in returning to his work at Woods Hole where he continued to study the process of fertilization with results that strengthened Lillie’s work and questioned Loeb’s idea of “superficial cytolysis.” According to Loeb’s studies, egg development could be initiated by exposing eggs to butyric acid. Development was then immediately followed by the release of lysine, Loeb’s cytolytic agent, to break down the egg cortex. Just showed that putting eggs in butyric acid for a short period of time actually slowed cytolysis rather than sped it up. Just was able to prove that the cytolytic effect of the butyric acid was due to overexposure of the eggs to the acid and nothing more. He went even further in dismissing Loeb’s experimental findings on artificial parthenogenesis, attacking Loeb’s method of record-keeping and his apparent failure to maintain experimental conditions to mimic his experimental organisms’ natural environments.

The friendship that Just and Loeb had forged together at Woods Hole quickly vanished. Their disagreements played out for many years, with Loeb providing negative evaluations of Just to the Rockefeller Institute and the Carnegie Foundation. Every time Just tried to obtain grant money, Loeb’s evaluations seemed to rise up and quell any grant award.

In 1929 Just made his first trip to Europe and worked at Anton Dohrn’s *Stazione Zoologica* in Naples. For six months he experimented with sea urchins (*Paracentrotus lividus* and *Echinus microtuberculatus*) to see how these organisms develop and to continue testing Lillie’s “fertilizin” theory of fertilization. Around 1906 Lillie had hypothesized that eggs release a substance that he coined fertilizin. Upon contact with spermatozoa, said Lillie, fertilizin causes sperm to attach to it. Lillie believed that fertilizin molecules served as receptors on the egg’s surface. With receptors for egg and sperm surfaces, the molecule helped to “agglutinate” egg and sperm together.

In 1930 Just was invited to the Kaiser Wilhelm Institute in Berlin where he continued his studies of the ectoplasm with other species, including *Amoeba*. Just strove to show the importance of ectoplasm in initiation of development. While in Europe he published three articles on the role of ectoplasm: “Die Rolle des kortikalen Cytoplasmas bei vitalen Erscheinungen” (“The Role of Cortical Cytoplasm in Vital Phenomena”) in *Naturwissenschaften* (1931) and “On Origin of Mutations” (1932) and “Cortical Cytoplasm and Evolution” (1933), both published in the *American Naturalist*. All three articles pointed to Just’s view that ectoplasm is necessary for fertilization to occur.

With little hope of ever being able to teach anywhere but a black college, and his continued failure to secure research funds, Just went to Europe in 1938 with the intent of leaving Howard and finishing out his research career on a new continent. In 1939 he published two books: *Basic Methods for Experiments on Eggs of Marine Animals* and *The Biology of the Cell Surface*. Both books reflected Just’s holistic view of eggs and embryos: that is, eggs are to be taken seriously in their own right rather than seen simply as tools to manipulate in order to prove a theory. While Just’s experiments may have been simple, he was an intense perfectionist when it came to laboratory procedure. His ability to keep laboratory environments similar to actual marine environments aided in the integrity of his research. It also led to his life-long criticism of experimental embryologists who failed to appreciate his tacit knowledge about inducing marine invertebrate reproduction. To Just, too many embryologists were busy taking eggs out of natural environments and subjecting them to unnatural manipulations while ignoring the importance of the eggs’ environment as an important factor in development. In *The Biology of the Cell Surface*, Just also continued his attack on the role of genes in development. He remained adamant that cytoplasm was the key to development and not the nucleus. This countered the growing enthusiasm by geneticists who held the idea that the nucleus

controlled fertilization and development.

The Nazi invasion of France in 1940 forced Just to return to the US and Howard University, one of the few institutions at the time that would hire a black scientist. His attempt to recareer again in the United States was short-lived however. Just died of pancreatic cancer on 27 October 1941.

Sources

1. Byrnes, Malcolm W. "Ernest Everett Just." *New Dictionary of Scientific Biography* 4: 66- 70.
2. Byrnes, Malcolm W., and William R. Eckberg. "Ernest Everett Just (1883-1941): An Early Ecological Developmental Biologist," *Developmental Biology* 296 (2006): 1- 11.
3. Gilbert, Scott F. "Cellular Politics: Ernest Everett Just, Richard B. Goldschmidt, and the Attempt to Reconcile Embryology and Genetics." In *The American Development of Biology*, eds. Ronald Rainger, Keith R. Benson, and Jane Maienschein, 311-42. Philadelphia, PA: University of Pennsylvania Press, 1988.
4. Gould, Stephen Jay. "Just in the Middle: A Solution to the Mechanist-Vitalist Controversy." In *The Flamingo's Smile: Reflections in Natural History*, 337-391. New York: W. W. Norton, 1985.
5. Just, Ernest E., "The Relation of the First Cleavage Plane at the Entrance Point of the Sperm," *Biological Bulletin* 22 (1912): 239-52.
6. Lillie, Frank R. "Obituary of Ernest Everett," *Science* 95 (1942): 10-11.
7. Manning, Kenneth J. *Black Apollo of Science: The Life of Ernest Everett Just*. New York: Oxford University Press, 1983.
8. Pauly, Philip J. *Controlling Life: Jacques Loeb and the Engineering Ideal in Biology*. New York: Oxford University Press, 1987.