



Marine Biology Connected to Developmental Biology, Eco-Devo Biology, Evolutionary Biology, and Evolutionary Bioethics: A Mini Review of Literature by and about Ernest Everett Just

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Introduction

Reviewing literature by and about marine egg cell biologist Ernest Everett Just (1883-1941) [1] shows that marine biology is connected to developmental biology, ecological developmental (eco-devo) biology, evolutionary biology, and evolutionary bioethics.

E. E. Just's accomplishments in biology are celebrated in *Black Apollo of Science: The Life of Ernest Everett Just* (1983) by MIT historian of science Kenneth R. Manning, and in *Vast Wonder of the World: Biologist Ernest Everett Just* (2018) by Mélina Mangal [2]. Also, in 1996 the US Postal Service issued a 32 cent Black Heritage postage stamp honoring "Ernest E. Just, Biologist."

E. E. Just taught biology at Howard University in Washington DC USA from 1909 to 1941, and he spent most summers doing research at the Marine Biological Laboratory (MBL) at Woods Hole. Just was first to observe that when the fertilizing spermatozoon penetrates the egg cell surface, a "wave of negativity" radiates from the point of penetration and sweeps around the cell surface, thereby repulsing all other sperm. During the 1920s and 1930s, Just became "the [original italics on the] current authority on fertilization" with a national and international reputation [3]. He wrote more than 70 published research articles and co-authored with Frank R. Lillie the chapter on "Fertilization" in Cowdry's 1924 *General Cytology: A Textbook of Cellular Structure and Function for Students of Biology and Medicine* [3,4].

Just Advanced Marine Biology

By teaching (first MBL researchers, then others) *Basic Methods for Experiments on Eggs of Marine Animals* [5],

By innovative fund-seeking and promoting research by women [3,6], and

By describing marine egg cell surface blocks to polyspermy, fertilization, cell-division, cell cleavage and differentiation, and early embryo development [1,3,7-23] culminating in *The Biology of the Cell Surface* [24].

In "Ernest Everett Just, PhD: Pioneer in Ecological Developmental (Eco-Devo) Biology" (2013) Katelyn M. Williams [24] and others offer the following Abstract:

[Abstract- “Ernest Everett Just, a pioneering American biologist, discovered the fundamental role of the environment in the development of embryos. His work led to the creation of the area of biology known as ecological developmental (Eco-Devo) biology. However, both his work and the context of his scientific contributions are not widely known. His work covered a diversity of fields of biology, including marine biology, cytology, and parthenogenesis (asexual reproduction where growth and development of embryos occur without fertilization). His findings provided important concepts in developmental biology that are used to this day. Specifically, he demonstrated the importance of the cellular cytoplasm and ectoplasm, in addition to the nucleus, in determining how development occurs in embryos. His work was unique for its use of in vivo conditions using a variety of marine organisms. His publications on the “Basic Methods for Experiments on Eggs of Marine Mammals” in 1922 [5] and “The Biology of the Cell Surface” in 1939 are still regarded as two of the most comprehensive reviews in cell biology. In this manuscript we present Dr. Just’s childhood in Charleston, SC, unlikely attendance and success at Dartmouth College, and his groundbreaking work, which was developed at the Marine Biological Laboratory (MBL) at Woods Hole, Europe, and Howard University.”]

Beyond developmental biology and eco-devo biology, The Biology of the Cell Surface [24] included a brief deliberation on cell surface co-operative behavior and theory of evolution.

This brief deliberation became a fully developed unpublished 1941 book manuscript—The Origin of Man’s Ethical Behavior (first published in 2020) [25] co-authored by Ernest Everett Just and Hedwig Schnetzler Just. In the opening chapter “The Problem Stated,” Just and Just reject the idea that theory of ethics (moral theory) should be restricted to religion and non-scientific philosophy. They say, “... we intend to treat ethics as a problem in biology ... It is within the field of biology, then, that we locate human ethics, or better to say, man’s ethical behavior” (Just and Just 1941: 2-3 [also 4, 91, 146]) [26,27]. According to Just and Just, cooperative behavior, which is essential to fertilization and embryo development, is essential to evolution. Developmental biology and evolutionary biology are governed by a comprehensive “law of environmental dependence” (dependence upon cooperative interactivity with a living environment). In tandem with the evolution of biophysical structures and functions, ethical behavior “evolved” from our “very most primitive fore-runner” (Just and Just 1941: 12 [also 17]) [27]. From cells to humans, the origin and evolution of cooperative behavior yields human capacity for evolving ethical behavior.

Without using the term bio-ethics or bioethics, Just and Just tied evolutionary biology to ethics, thereby advancing “evolutionary bioethics” (Walker) [28,29].

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