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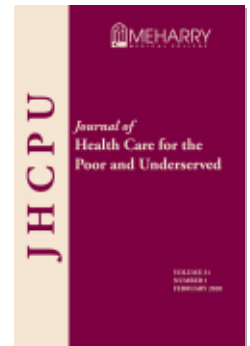
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Ernest Everett Just (1883–1941): Hero in Cell Biology and Evolutionary Bioethics

Theodore Walker Jr., PhD

Abstract: Ernest Everett Just is celebrated for his contributions to cell biology. Among other firsts, he was first to describe the “wave of negativity” spreading around an egg cell from the entrance point of the fertilizing spermatozoon. His accomplishments in biology are celebrated in *Black Apollo of Science* (1983) by Kenneth Manning, and by a 1996 Black Heritage postage stamp. What is not yet widely appreciated, however, is that Just connected evolutionary biology to ethical behavior (1933, 1939, 1940). He was probably the first cell biologist to argue that human ethical behavior *evolved* from our very most primitive cellular origins. Today, Just’s contributions to evolutionary bioethics, including “the law of environmental dependence,” can be better appreciated because his unpublished book-length manuscript, “The Origin of Man’s Ethical Behavior” has been preserved at Howard University’s Moorland-Spingarn Research Center.

Key words: Cell biology; egg cell; fertilization; cell surface; ectoplasm; evolutionary biology; ethics; evolutionary bioethics; environmental dependence; ethical behavior, origin of.

Appreciating Ernest Everett Just’s Contributions to Biology

Ernest Everett Just (born 1883, died 1941) taught biology in the Department of Zoology at Howard University in Washington D.C. from 1909 to 1941. Even though Just is seldom cited in biology textbooks, all of us have learned what Just first observed and described: when the fertilizing spermatozoon penetrates the egg cell surface, a “wave of negativity” radiates from the point of penetration sweeping around the egg cell surface, thereby repulsing all other sperm.¹ During the 1920s and 1930s, Just was “*the* [original italics on *the*] current authority on fertilization” with a national and international reputation.² [p.149] Just wrote more than 70 published research articles, and co-authored with Frank R. Lillie the chapter on “Fertilization” in Cowdry’s 1924 influential edited volume, *General Cytology: A Textbook of Cellular Structure and Function for Students of Biology and Medicine*.³ Additionally, Just published two books as sole author, both in 1939: *The Biology of the Cell Surface* and *Basic Methods for Experiments on Eggs of Marine Animals*.^{4,5}

Just’s influence endures. Since his pioneering studies, cell surface research has become vitally important for biology, biochemistry, and biophysics.^{6,7} In marine biology, Just’s

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Ernest Everett Just

basic methods⁵ encouraged rigorous attention to the natural environment of living-developing-procreating specimens. Prior to Just, marine biologists were habitually working from killed-and-fixed specimens extracted from living environments. Just criticized and corrected findings and concepts derived from such environmentally insensitive methods. In ecological development biology, in integrative systems biology, and in embryo morphogenesis, Just is acknowledged as a pioneer.^{1,8–11*}

Trending

Following his death in 1941, after four decades of virtual neglect, Just's work is being increasingly appreciated and celebrated. This trend started with the biography *Black*

*Concerning Just as *pioneering* biologist, see "Ernest Everett Just, PhD: Pioneer in Ecological Development (Eco-Dev) Biology" (July 2013) by Katelyn M. Williams, Bryan A. Wilson, Wendi G. O'Connor, and Monte S. Willis in the *Journal of the South Carolina Academy of Science*, 11 (1): article 5; and see "Ernest Everett Just (1883–1941)—An early ecological developmental biologist" (1 August 2006) by W. Malcolm Byrnes and William R. Eckberg in *Developmental Biology*, 296 (1): 1–11. Also, concerning eco-dev biology and integrative systems biology, in "Ernest Everett Just: Experimental Biologist Par Excellence" (February 2010), W. Malcolm Byrnes describes ecological developmental biology as focusing "on development in its natural environmental context," and he emphasizes Just's challenge to established views, a challenge that has "much in common with what is known today as integrative systems biology, in which a top-down view is just as important as a bottom-up view [bottom-up is an established reductionist view] for understanding the system" (Byrnes February 2010). Just's early advocacy of a non-reductionist/holistic approach is appreciated in "Just and Unjust: E. E. Just (1883–1941)" (August 2008) by James F. Crow in *Genetics*, 179: 1735–1740. In embryo morphogenesis, Just strongly influenced essential concepts (concepts usually attributed to Holtfreter), according to "Ernest Everett Just, Johannes Holtfreter, and the Origin of Certain Concepts in Embryo Morphogenesis" (2009) by W. Malcolm Byrnes in *Molecular Reproduction & Development*, 76: 912–921.

*Apollo of Science: The Life of Ernest Everett Just*² by Kenneth R. Manning (MIT historian of science), followed by Anne Fausto-Sterling's "Biography of a Black Research Scientist."¹² Manning's award-winning book inspired many celebrations of Just's work. In 1996, the U.S. Postal service issued a Black Heritage postage stamp honoring Just as biologist (pictured above).

Subsequent celebrations include: a solo theater piece titled "The Division of Memory" (2001) created by Clarinda Mac Low and James Hannaham,¹³ a book in juvenile literature *The Vast Wonder of the World: Biologist Ernest Everett Just* by Méline Mangal,¹⁴ and a play titled *The Biology of the Cell Surface* by Dominic Taylor.¹⁵ In addition to increasing numbers of articles, books, Black heritage posters, and plays, no doubt, there will someday be a video drama or movie about Just. No doubt, too, video will include Just's internment (August 1940) and dramatic escape (early September 1940) from Nazi-occupied France (with rescue help from the well-connected German family of his second wife, Hedwig Schnetzler Just), his return to Howard University (late September 1940), and his death at age 58 from pancreatic cancer on 27 October 1941.²

Increasingly, we are learning to appreciate Just's contributions to biology. What is not yet widely appreciated, however, is that Just did important work connecting biology to ethics, including environmental ethics.

Appreciating Just's Contributions to Bioethics

The term "bioethics" was first used in an article by Fritz Jahr (1895–1953) titled "Bioethics [Bio-Ethik]: A Panorama of the Human Being's Ethical Relations with Animals and Plants"^{16,17} and probably first used in a book title in 1971—*Bioethics: Bridge to the Future* by Van Rensselaer Potter (1911–2001).¹⁸ Potter, who appears to have known nothing about Fritz Jahr's work, dedicated his book to the memory of Aldo Leopold (1887–1948), a land and forest conservationist "who anticipated the extension of ethics to Bioethics."¹⁸[p.v] In his 1988 book, *Global Bioethics: Building on the Leopold Legacy*,¹⁹ Potter identified Aldo Leopold as "unquestionably the first bioethicist" because Leopold was "first to envision a new ethical basis for human conduct" and "first to develop an ecological ethic (which he called the land ethic) . . ." ¹⁹[p.xiii] In addition to Fritz Jahr who in 1927 was advancing "a 'Bioethical Imperative,' extending Kant's moral imperative to all forms of life . . . human and nonhuman . . .," ¹⁷[Abstract] Aldo Leopold was pioneering bioethics²⁰[p.xiv] with his "land ethic," and Ernest Everett Just was pioneering environmental and evolutionary bioethics with his cell-biology-rooted theory of ethical behavior.^{4,21}

For most English-only readers, and for many others, the first time we encountered the term "bioethics" was in Potter's book. In contrast to the generic meaning (= biology + ethics) very quickly the term "bioethics" came to mean medical or biomedical ethics. This special meaning prevailed throughout the many articles and books listed (only four years later) in the *Bibliography of Bioethics*.²² Similarly, "bioethics" had become "biomedical ethics" in the widely read *Principles of Biomedical Ethics*.²³ In 1988, H. Tristram Engelhardt Jr. reported that the term "bioethics" serves "to identify the disciplined analysis of the moral and conceptual assumptions of medicine, the biomedical sciences, and the allied health professions."¹⁹[Preface p.x] As indicated in Potter's book title, *Global Bioethics*, Engelhardt acknowledged that, as used by Potter, the term "bioethics"

had a very wide scope. Nevertheless, as indicated in the *Encyclopedia of Bioethics*,²⁴ the narrow scope prevailed.

Before general bioethics was narrowed to biomedical ethics, there had been ethicists working on medical and health care issues. For one example, see the 1954 book, *Morals and Medicine: The Moral Problems of: The Patient's Right to Know the Truth, Contraception, Artificial Insemination, Sterilization, Euthanasia* by Joseph F. Fletcher.²⁵ Even earlier, starting with Darwin,²⁶ biologists, zoologists, and other scientists had been trying to relate evolutionary biology to ethics. Some early evolutionary biologists and ethicists were reevaluating the natural scientific emphasis upon struggle for survival and survival of the fittest²⁷ because such emphasis made ethical behavior seem unnatural.

In 1902, Russian zoologist Peter Kropotkin argued that ethical behavior (mutual aid and co-operation) is as much and likely more a factor in evolution than competitive struggle.²⁸ He predicted that evidence confirming the evolutionary importance of mutual aid would someday emerge from the study of micro-organisms. Just offered such confirming evidence.^{4,29,30}

In his 1939 book, *Biology of the Cell Surface*,⁴ Just supplemented a Darwinian emphasis—upon struggle against the surrounding environment—by adding a Kropotkinian emphasis upon mutual aid and co-operation with the surroundings. Just wrote:

Life is not only a struggle against the surroundings from which life came; it is also a co-operation with them. The Kropotkin theory of mutual aid and co-operation may be a better explanation of the cause of evolution than the prevailing popular conception of Darwin's idea of the struggle for existence. [And with cells] The means of co-operation and adjustment is the ectoplasm [the living cell surface].^{4[p.367]}

Just described co-operation mediated by the cell surface. “Here,” among non-reductionist theories of life instructed by observations from cell biology, “we may seek the roots of man's ethical behavior.”^{4[p.367]} In his final footnote, Just said he would “deal with this point at greater length” in a “forthcoming” work.^{4 [p. 367]}

Regrettably, before he could persuade a publisher to print said forthcoming work on the roots of human ethical behavior, Just died (on 27 October 1941). Thankfully, in May 2018, “The Origin of Man's Ethical Behavior” (unpublished but written in 1941) was discovered among the collected papers of E. E. Just at the Howard University Moorland-Spingarn Research Center. According to Just and his co-author Hedwig Schnetzler Just, human ethical behavior *evolved* from our most primitive cellular origins.

Probably, in 1939, when *Biology of the Cell Surface* was printed, Just was the first cell biologist to root ethical behavior in evolution processes that reach all the way back to the evolution of co-operation among our earliest cellular ancestors. And, probably, in 1941, E. E. and H. S. Just were first to formulate a comprehensive “law of environmental dependence.”^{21[pp.157–168]}

For many theories of evolution, nature is “red in tooth and claw” (Tennyson), and ethical behavior is unnatural. By contrast, for the Just and Just theory of evolution, ethical behavior evolves naturally.^{31–34*} And therefore theory of ethics (moral theory)

*Contemporary microbiologists and contemporary zoologists are rediscovering what Just discovered during the 1930s. In microbiology, Jeffrey Marlow and Rogier Braakman wrote “Team Players: Long

should be a natural science. (Just followed Adolf von Harnack in conceiving that theology and ethics are correctly subject to natural scientific inquiry such as natural theology and natural ethics.) According to Just and Just, from cells to humans, a natural law of environmental dependence influences both the evolution of biological-physiological structures and the evolution of social-ethical behaviors. Such evolutionary bioethics is essential to advancing both evolutionary biology and “evolutionary ethics.”³⁵

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thought mostly to compete with one another, microbes turn out to form partnerships that rule the planet” (November 2018 [*Scientific American*, volume 319, number 5, pp. 32–39]). The idea of partnerships, cooperation, and mutual aid among microbes had been advanced briefly in *Biology of the Cell Surface* (Just 1939 [Also, Just 1933, Just 1940]) and at length in “The Origin of Man's Ethical Behavior” (Just and Just 1941). Also, see *An Elegant Defense: The Extraordinary New Science of the Immune System: A Tale in Four Lives* (2019) by Matt Richtel. Similarly, in zoology, contemporary researchers are discovering ethical behaviors among primates. For instance, see *The Bonobo and the Atheist: In Search of Humanism among the Primates* (2013) by Frans B. M. de Waal. Bonobo studies and atheists agree that ethical behavior can be explained without exclusive appeal to top-down influences such as God-to-humans (religion) or transcendental-logic-to-humans (philosophy) because there is ethical behavior among primates and among other subhuman animals; and this indicates human ethical behavior is influenced from below, “bottom-up morality” (title of concluding chapter 8). By contrast, according to the Just and Just account of cellular origins, evolution, and environmental relations, there are bottom-up, horizontal, and top-down influences upon the evolution of ethical behaviors. The idea that morality evolved (Just 1939, Just and Just 1941) was rediscovered and advanced in *Evolved Morality: The Biology and Philosophy of Human Conscience* (2014) edited by Frans B. M. de Waal, Patricia Smith Churchland, Telmo Pievani, and Stefano Parmigiani.

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