

Obituary

George Wald (1906–97)

Biologist who discovered the role of vitamin A in vision

George Wald died on 12 April 1997, at his home in Cambridge, Massachusetts. He was 90. Wald's main scientific achievement was the discovery of the function of vitamin A in vision. Beginning with research dating to the early 1930s, he showed that the light-sensitive molecules, the visual pigments, found in the photoreceptor cells of the retina, consist of a protein (opsin) to which is bound a slightly oxidized form of vitamin A (vitamin A aldehyde, now termed retinal). Retinal serves as the chromophore for these molecules, absorbing the light and initiating conformational changes in the protein that lead eventually to the excitation of the photoreceptor cells. Wald's findings represented the first instance that a biochemical function for a fat-soluble vitamin had been established and were widely recognized.

Wald was born on 18 November 1906, in New York City. He grew up there and graduated from Washington Square College in 1927. He moved to Columbia University for graduate work, and studied there with Selig Hecht who was to introduce Wald to visual physiology. Hecht was the major figure in visual physiology of his generation; his quantitative studies of visual phenomena provided some of the first evidence that visual mechanisms can be explained in terms of physics and chemistry. Wald and his co-workers would eventually set many of Hecht's concepts into precise molecular terms.

Wald received his PhD degree in 1932 and spent the next year, his *Wanderjahr*, in Europe with three Nobel laureates — first with Otto Warburg in Berlin-Dahlem, then with Paul Karrer in Zürich and finally with Otto Myerhof in Heidelberg. It was during this momentous year that Wald identified vitamin A in the retina and gained the first glimpses of the part that it plays in vision. After a year at the University of Chicago he assumed his first academic position as tutor in biochemical sciences at Harvard. He remained at Harvard for all of his academic career, attaining full professorial status in 1948. He retired in 1977 as Higgins Professor of Biology.

Wald's research career centred almost exclusively on the chemistry of the visual pigments and related phenomena. Beyond his early fundamental discovery of the role of vitamin A in vision, he and his

colleagues made innumerable contributions to the biochemistry of the visual pigments. These included extensive studies on the chemistry of the rod pigment, rhodopsin, and the extraction and characterization of the first known cone pigment, iodopsin. His laboratory also elucidated the role of *cis-trans* isomerization in the visual process, demonstrating for the first time that such molecular transformations are involved in biological processes. He and his colleagues also provided insights into the diversity of visual pigments, vitamin A deficiency, visual adaptation, colour vision and the absorption properties of the cone pigments in primates, including man. No laboratory of that time added more to our understanding of the visual pigments and their relation to vision than did George Wald's. For his enormous contributions, Wald received the Nobel Prize in Physiology or Medicine in 1967, sharing the prize with the visual neurophysiologists H. Keffer Hartline and Ragnar Granit.

George Wald was a superb teacher, writer and lecturer. His interests ranged widely, and he had a special gift of drawing together diverse observations to make startling generalizations and proposals. Long before anyone had conceived of the notion that visual excitation might involve a biochemical cascade, he made such a proposal based on the then newly elucidated blood-clotting cascade. His studies on the distribution of the two forms of vitamin A found in nature (vitamin A₁ and A₂) led him into the field

of biochemical evolution, and he wrote superb and provocative articles on this topic with such varied titles as "The significance of vertebrate metamorphosis", "Life in the second and third periods; or why sulfur and phosphorus for high energy bonds?" and "The origin of optical activity". To his highly entertaining lecture "The origin of life", he added a sequel, "The origin of death"; both were enjoyed by audiences the world over.

Wald's courses at Harvard were exemplary for their wit and clarity. He taught introductory biochemistry to generations of Harvard students and, for 16 years, from 1960 until his retirement, a year-long introductory biology course entitled "The nature of living things". This course was part of the General Education Program at Harvard, taken both by students intending to concentrate on biology and by others. In 1966, *Time* magazine, in a cover story, named Wald "one of the ten best teachers in the country".

Wald was one of the first in academia to speak out against the Vietnam War, and in 1969 he gave a speech at the Massachusetts Institute of Technology that was to affect the rest of his life. The speech, "A generation in search of a future", immediately endeared him to the anti-war community and resulted in his becoming a forceful spokesman against the Vietnam War, nuclear arms proliferation and a variety of other political issues. In this, his wit and clarity of expression served him well. When confronted with the view that the arms race and the peacetime draft were "facts of life", he replied "No, those are the facts of death. I don't accept them and I advise you not to accept them". After his retirement in 1977, Wald gave up laboratory research and devoted his time to political causes. He travelled widely espousing his views until the last two years of his life.

When Wald received the Nobel prize in 1967, he remarked that "A scientist lives with all reality. There is nothing better. To know reality is to accept it and eventually to love it. A scientist is in a sense a learned child. There is something of the scientist in every child. Others must outgrow it. Scientists can stay that way all their lives". All who knew George Wald were profoundly affected by him. As Wald spoke of Hecht, his mentor, we speak of Wald: "He cast his light widely and many found their way by it".

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