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# Comments on Haldane's Paper on the Origin of Life

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In this short but brilliant essay of eight pages, Haldane has compressed the leading ideas of the origin of life, which entitle him to be named, with Oparin, of whose work he knew nothing, as the joint originator of modern views on the origin of life. It contains, together for the first time, the two leading ideas which have run through the whole development of the subject: the existence of intermediate forms, in his case those of viruses, in particular bacteriophage d'Herelle; and the idea of an atmosphere that originally contained no oxygen. From the latter he draws the conclusion that at the time of the origin of life ultra-violet light reached the Earth from the Sun and was not cut off by the ozone layer, which would have been present had there been oxygen in the atmosphere. Hence the synthesis of the primitive soup.

As to the experimental basis, Haldane drew, not on Miller, who had not yet performed his experiments, but on Baly of Liverpool, who had shown the ultra-violet induced synthesis of sugars. Primitive organisms, he thought, must have obtained their energy from their food by fermentation, which follows from Pasteur's definition of fermentation as "life without oxygen".

Haldane realized that the first organisms could not have been as complicated as even the bacteria today, because the latter are organisms containing systems whose parts cooperate and, consequently, systems which require only a few types of molecules to live on.

He realized, further, that the unity of life is based on the asymmetric character of its molecule. At the end of his essay he speculated as to whether he would live to see artificial enzymes. This he certainly did, for the protein insulin, though strictly a hormone and not an enzyme, was synthesized in 1963.

The origin of life will remain a subject for speculation until a self-contained organism is made, but, as Haldane wrote, "such speculation is not idle, because it is susceptible to experimental proof or disproof". He neatly turns the argument about the incompetence of the scientific man on the subjects of the relations of mind and matter by saying that "the biochemist knows no more and no less about this question than anyone else. His ignorance disqualifies him no more than the historian or the geologist from attempting to solve a historical problem".

He speculated further as to whether the bacteriophage might not be a gene, about which very little if anything was known at that time apart from its deduction from Mendelian genetics. In a sense, he had followed out the mental processes needed to establish the gene as a material object, without expressly stipulating what kind of material object it was, certainly without any suspicion of the role of DNA.

On reading this essay, one is struck by the extreme justice of Haldane's views and by how far he anticipated things which occurred many years after he had written of them.

It is characteristic of science that the full explanations are often seized in their essence by the percipient scientist long in advance of any possible proof. X-ray analysis and the use of the electron microscope were to elucidate, many years later, the nature of the virus and its action, and this, in turn, was to provide an important clue in the essential coding of nucleic acids into proteins.

However, at the time, Haldane's ideas were dismissed as wild speculations. Only the clarity and beauty of his style and the attractiveness of his character ensured that they were read, albeit in small circles.