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Comparisons of Darwin and Wallace's Theories of Natural Selection

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Abstract: *Charles Robert Darwin and Alfred Russel Wallace have different views on the analogy between natural and artificial selection. Darwin thought about the mechanism of species change by investigating the variation of animals and plants in the domesticated state. Wallace also believed in evolution during his field trip, but he was not interested in the experiment in domestication and firmly denied that artificial selection could be comparable to natural processes. There are also very different views on the dimorphisms of males in animals on both sides. Darwin admitted that natural selection failed to explain the apparently meaningless luxury of the "dazzling tail of the male peacock". He also believed that certain traits are not fought for survival but to reproduce more offspring. With regard to the origin of man, Darwin insisted on the validity of natural selection, which he believed was the result of human evolution, both physically and intellectually and morally. In contrast, Wallace believes that natural selection cannot explain the origin of advanced human intelligence and that it was after a study of divine phenomena that Wallace has found reliable evidence to solve the problem.*

Keywords: *Darwin; Wallace; Natural selection; Secondary sexual characteristics; Human origin*

1. Preface

Alfred Russel Wallace (1823-1913) coincided with Charles Robert Darwin (1809-1882) in the same period in proposing a theory of evolution based on natural selection. However, Wallace has remained invisible to the public, and people tend to attribute one of the greatest discoveries of the nineteenth century, biological evolution, entirely to Darwin's personal achievements. In this history of science, however, it is evident that Wallace and Darwin still had different and controversial views on many specific aspects of evolution and its related issues.

In February 1858, Alfred Russel Wallace discovered that the struggle for survival of organisms by superiority and inferiority could be the driving mechanism of natural evolution, and wrote a paper, On the Tendency of Varieties to Depart Infinitely From the Original Species, which he sent to Charles Robert Darwin. In response, Darwin adjusted his writing schedule and published a full-length summary of his original monograph, On the Origin of Species by Means of Natural Selection, or the Preservation of the Favored Races in the Struggle for life, in November 1859, kicking off the "Darwinian Revolution" [1].

In the 1980s, Peter J. Bowler, a revisionist of the history of science, proposed the concept of "Non-Darwinian revolution", calling for a shift in focus from Darwin to other contemporary evolutionists in the history of evolutionary biology, comparing the similarities and differences between Darwinian and "non-Darwinian" evolutionary ideas and "reinterpreting a historical myth". Wallace is undoubtedly the ideal subject for this "non-Darwinian industry" [2]. A comparison of the theoretical differences between Wallace and Darwin after their meeting under the banner of Darwinism reveals the real situation of the doctrine of natural selection before the "Mendelian revolution", which was internal and external. According to Kottler, an early researcher, they disagreed on sexual dimorphism, crossbreeding-hybrid sterility, and the origin of human beings[3].

2. The Different between Darwin's and Wallace's Theories of Natural Selection

2.1 Applicability of Natural Selection and Artificial Selection by Analogy

In the Origin of Species, Darwin Darwin analyzed in detail the breeds of domestic pigeons and the

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differences between them and their origins. Among his findings, although there are many species of domestic pigeons and obvious differences among them, such as the spherical shape of the crop of the globe-breasted pigeon when it swells, the fluffy feathers on the neck of the collared pigeon like a scarf, etc., they still share common features, such as the fact that they all feed their chicks with a milky substance secreted from their crop，the occasional reappearance of blue and black markings in both pure and mongrel species，the fact that their hybrid offspring are completely fertile, and so on. However, all these common features resemble a wild rock pigeon. Taking all these reasons together, Darwin concluded that all the different species of domestic pigeons originated from the rock pigeon[4]. In addition, Darwin collected a wide range of relevant information and communicated closely with breeders, animal lovers, etc., which led to the conclusion that certain traits acquired by domesticated plants and animals are associated with deliberate human selection.

In order to find conclusive evidence of species variation, Darwin argued for the prevalence of species variation in the domesticated state, starting with artificial selection. An Essay on the Principle of Population by Thomas Malthus argued that population growth beyond resources, which in turn led Darwin to realize that the reproductive capacity of living organisms is incredible, and that the growth in the number of their offspring always far exceeds the growth in the resources that the environment can provide. In such a situation, the struggle for life is inevitable. Thus, Darwin concluded that individuals with dominant traits were more likely to have a better chance of survival. This is natural selection, which creates adaptive traits and gives rise to new species.

Darwin also mentions the difference between natural and artificial selection in the fourth part of The Origin of Species. First of all, the active agent of selection is different, the former is "nature", while the latter is mainly the will of human beings. Then, the traits that were selected for differed in that the former selected and accumulated those traits that were beneficial to the organism itself, while the latter selected traits that were only beneficial to humans [5]. Why, in that case, did the authors not discuss directly the variation in the natural state, rather than studying the variation in the domesticated state first? As Darwin noted himself, natural selection is working at a very slow rate, whereas artificial selection takes place over a short period of time and under more unstable living conditions, making the variation under artificial breeding more obvious, easier to observe, and better known.

Although Wallace had no practical experience in domestic breeding, he began his Tendency by arguing that the variants of domesticated animals cannot be compared to those in the natural state. In fact, he regarded domesticated animals as "anomalous", which would never occur in a natural state. Wallace noted that variants in the natural state would become more and more unlike their ancestors under the action of natural selection mechanisms, while domesticated variants, once they became wild animals, would inevitably revert to types close to their parent species or become completely extinct under the action of natural selection mechanisms. The differences between domesticated animals and wild animals were also thoroughly analyzed by Wallace. He argues that the survival and safety of wild animals depends entirely on the health and functioning of all their senses, but those of domesticated animals are only partially functioning, and in some cases, completely useless. In the wild, every bite of food requires an effort to find and struggle. In the hunt for food, to escape danger and protect their offspring, wild animals must exploit their organs of sight, hearing and smell. The muscles in their bodies are constantly active, and their senses or movement are enhanced due to frequent movement and exercise. In contrast, domesticated animals have a ready supply of food, a living site, by contrast, and live virtually unaffected by seasonal changes as well as by enemy attacks. In such a case, half of their sensory functions are hardly useful, while the other half is used at times only, for which their muscular system is not always activated [6].

Wallace believes that even if the domesticated animal produces a variant with an enhanced organ or sensory ability, it is useless. This is because breeders select only those variants that are beneficial to their own needs, without the animals themselves necessarily benefiting. On the contrary, wild animals, in order to survive, all their functions and strengths are fully developed, and as long as there is a little improvement, it will immediately be exploited by them. Breeders focus only on those variations in domesticated animals that are beneficial to them, while those that enhance the survival of wild animals become negligible variation traits for domesticated animals. Pigs with fast fat growth, short-legged sheep, bulbous-breasted pigeons and poodles would certainly not be found in the natural state. Because this form of mutant characteristics will be immediately wiped out as soon as they appear, not to mention to compete with their wild counterparts. Racing horses are able to run at high speed, but lack endurance. Broilers are bred to meet the people' s need for food only, and are of little use in their natural condition. If this type of animal is allowed to live wild in the grasslands of South America, it may soon be extinct, or in favorable conditions, they would gradually disappear those distinctive

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features that never work, and after a few generations will revert to the ordinary type[7].

According to Wallace, there were limitations and instabilities in artificially bred variants, which could not have produced new species.In other words, if natural selection and artificial selection were really the same selection process, then this analogy would suggest that natural selection does not have the ability to form new species. Therefore, Wallace denied the analogy between the two by emphasizing the differences between domesticated breeding and wild variants. Apparently, such demonstration is based on the assumption that "The processes of formation of variants appearing under certain natural conditions are perfectly analogous, even identical, with those of domesticated animal variants, so that their permanent constancy and further variability are governed by the same laws, but the purpose of this paper is to to show that this assumption is entirely false." [8]

It thus appears that Wallace was strongly opposed to using the variation that occurs in domesticated animals to infer the persistence of the variant in its natural state. He believes that the two types of animals live in completely different situations. Domesticated animals are anomalous, irregular, and artificially bred, whose mutations would never occur in a natural state, and whose appearance is entirely dependent on human breeding. Domesticated animals have sufficient food and safe living environment, where they completely lose the coordination of their functions and the real balance of their organization, on which wild animals depend to maintain themselves and to perpetuate the survival of their offspring [9].

Unlike Wallace, Darwin considered the variation of domesticated animals (artificial selection) as a very meaningful analogy for exploring and explaining the mechanism of evolution (natural selection). Ernst Mayr (1904-2005) believed that direct evidence for Darwin's derivation of a mechanism of natural selection for evolution came from the analogy of natural selection to artificial selection. Michael Ruse also agreed with this Darwinian analogy, arguing that once Darwin was convinced of the analogy between artificial and natural selection, he used it as a sturdy and reliable hilt of the sword [10]. Thus, Darwin not only discussed the issue of variation in domesticated animals in the first chapter of his book The Origin of Species, but also, a decade later, published his book The Variation of Animals and Plants under Domestication(1868), which further emphasized the importance of artificial selection.

2.2 Different Interpretations of the Secondary Sexual Characteristics

Darwin's book, The Decent of Man,and Selection in Relation to Sex, published in 1871, elaborated on the theory of sexual selection and immediately attracted widespread attention, especially from opposing views. Arguably, in the 19th century, the most prominent critic of sexual selection was Wallace. In fact, according to George John Romanes, to consider all the objections to the theory of sexual selection is to say, virtually, that for now and for all intents and purposes, it is only Mr. Wallace's opinion on the subject that counts.

Wallace insisted that whether it was "weapons" used to compete for mates, such as horns, canines, or hind claws on vertebrate males (which Wallace recognized as "weapons"), or brilliant colors, appealing ornaments, or beautiful sounds on males to attract females (Wallace believed that animals could not have the same mental abilities and feelings as humans, so individual females would have no ability to appreciate male beauty or ugliness, good or bad sounds), these are the result of natural selection (e.g., protection, recognition), rather than sexual selection as Darwin suggests. On this issue, Wallace indeed appears to be more of a Darwinist than Darwin himself. In response, Cronin suggested with great seriousness that Wallace and his successors were largely to blame on the issue of sexual selection because they left a legacy for Darwin by making it disappear for 100 years. As a matter of fact, in the late 19th and early 20th centuries, there were many people besides Wallace who argued fiercely against the theory of sexual selection [11].

Later in the 20th century, Julian Sorell Huxley (1887-1975), one of the founders of modern evolutionary synthesis theory, was a fierce critic of sexual selection theory. His grandfather was Thomas Huxley, known as "Darwin's Bulldog" for his advocacy of Charles Darwin's theory of evolution. In the 1930s, Huxley wrote several papers against Darwinian sexual selection. He claimed that Darwin regarded male bright colors and other conspicuous traits as too sexually functional and attributed all these traits to natural selection. Because of Huxley's authority in biology at the time, his views were generally accepted. It was not until the latter half of the 20th century that some scholars of sexual selection theory pointed out that Huxley's views were incorrect, arguing that he confused natural selection with sexual selection and used a lot of inexplicable language to confuse the issue of sexual selection[12].

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The theory of sexual selection has not achieved true recognition until 100 years after the publication of The Decent of Man, and Selection in Relation to Sex. There are two theories that deserve to be highlighted. One is the theory of parental investment, proposed by evolutionary behaviorist Robert L. Trivers (1943-) in 1972, and the other is the theory of runaway sexual selection, proposed by Ronald Aylmer Fisher (1890-1962), one of the founders of population genetics. However, Fisher's theory was raised in 1930 and became officially recognized in 1980.

2.3 Human Origins

The key contradiction between Darwin's and Wallace's theories is their disagreement about human origins. This is the most complex aspect of the discussion of their theories, because it is a matter of differences in the understanding of the doctrine of "natural selection" and the way in which both sides understand the natural sciences in addressing the question of human origins. Although in the case of the evolution of plants and wild animals, the two were still working together to defend the authority of natural selection in science as far as possible within the framework of naturalism, it was when confronting such a sensitive issue as human evolution, that Wallace's strong adaptationism was literally challenged. Darwin was convinced that humans originated from some type of animal inferior to humans, i.e., that the laws of natural evolution applied equally to human origins. In contrast, Wallace believed that strong adaptationism had an explanatory role in the physical evolution of man, but in the evolution of human spiritual life, he was stuck and could not continue to pursue a naturalistic approach within the framework of Darwin. Therefore, Wallace turned to the mystical, supernatural spiritualism and introduced it into his theoretical system.

In The Origin of Species, Darwin does not specifically discuss the origin of human beings, but only mentions in the closing part of the book, "The origin and history of mankind, too, will thus be greatly enlightened" [13].

Darwin first started with the contrast between the physical structure of humans and animals, and he cited a large number of facts to argue that humans and animals have certain similarities and continuities. Darwin concluded that animals were also able to use language to express their intentions. When expressing feelings that are relatively simple and active, humans, like animals, tend to express the emotions of their feelings through various gestures and facial muscle movements. Darwin believed that the difference between humans and animals lies entirely in the ability of humans to connect a wide range of sounds and ideas together. Compared to animals, such ability is almost infinite, resulting from the fact that humans are more developed in various mental abilities[14].

In March 1864, Wallace read an article at the Anthropological Society of London that applied the theory of natural selection to explain the origin of man, which was entitled "The Origin of Human Races and the Antiquity of Man Deduced From the Theory of 'Natural Selection". In this article, Wallace admitted that the different human races all came from the same animal ancestor, and that the differences in physical characteristics (e.g., skin color, hair color, eyes) between races were simply the result of selective preservation to adapt to different environments.

However, Wallace further emphasized the special nature of human evolution. He argues that man evolved, in the true sense, not physically, but mentally. " With the continuous development of the human intellect, the physical structure of man became fixed and remained unchanged, and 'natural selection' soon gave dominance to the mind. Language was probably the first to develop, and led to a steady advance of mental faculties. The manufacture of various artifacts, the division of labor, a sense of morality, social responsibility, and compassion that would play a dominant role in the gradual evolution of man were all important components of 'natural selection' working powerfully on man." According to Wallace, human evolution is divided into two stages. The first stage is the physical evolution of human beings, while the second stage is the spiritual evolution, both of which are phased in nature. In other words, with the continuous evolution of mental ability, the most intelligent and moral people could better adapt to the environment and obtain the best survival [15].

Wallace believed that humans have some kind of soul power that is separated from the body, and that human intelligence is guided by a "superintelligence". It is clear that Wallace believed that human evolution, especially spiritual evolution, could no longer be explained by natural selection alone, and that these unique characteristics of human beings came from some supernatural force. In this way, it can be seen that the idea of creationism has made a comeback. On the subject of human origins, Wallace's strong adaptationism encountered a dilemma, and in order to find a way out, he turned to the so-called "deity" theory of the universe to improve his theory.

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With regard to the origin of human advanced intelligence and spiritual nature, Darwin still insisted on the serious scientific theory of natural selection to explain it, while Wallace believed that only the introduction of spiritual ideas could explain those uniquely human non-adaptive phenomena. The disagreement between Darwin and Wallace on this issue can no longer be attributed solely to their different degrees of adaptationism, but is more fundamentally due to a major difference in their understanding of science and religion (theology).

The reason why Wallace diverged from Darwin as an agnostic on the human origins was mainly due to the gradual recognition of spiritual phenomena, which led him to doubt natural selection and inspired him to rethink the meaning of the existence of the unique traits of human beings.

3. Summary

Darwin and Wallace had distinctly different views on the analogous applicability of natural and artificial selection. Darwin used analogy to extend the theory of artificial selection to the doctrine of natural selection, seeking to enhance the explanatory power of the doctrine of natural selection. By studying the variation of plants and animals in the domesticated state, Darwin came up with the mechanism of species change. However, Wallace, who believed in evolution during his fieldwork, was not interested in experiments on domesticated breeding and firmly denied that artificial selection could be analogous to natural processes.

Furthermore, their views on male and female dimorphism in animals differed significantly. Darwin recognized that natural selection was indeed incapable of explaining apparently meaningless luxuries such as the "big dazzling tail of the male peacock. He proposed the theory of natural selection as an alternative solution. Some traits, Darwin argued, were not for the struggle to survive, but to reproduce more offspring. In sexual selection, Darwin proposed two different components to explain male and female dimorphism. On one hand, the well-developed horns, strong teeth, large body and other male traits are "weapons" in order to compete for females and gain access to breeding. On the other, beautiful feathers, melodious voice, graceful dance and other male traits are not used in a direct struggle, but to win over females for the purpose of mating with them. Wallace expressed agreement with the first part of sexual selection and believed that it could also be explained by natural selection. However, for the second part, Wallace considered it to be a hypothesis lacking in evidence and accompanied by a strong anthropomorphism, insisting on strong adaptationism to explain the secondary sexual characteristics of animals.

Regarding the origin of human beings, Darwin insisted on the validity of natural selection, and he believed that the evolution of human beings, whether physically or intellectually or morally, was the result of natural selection, and that there was no essential difference between humans and animals, but only a difference in the degree of evolution. on this issue, Darwin replaced the image of God in all its forms with a purely objective theory of natural selection, admitting that he was an agnostic. On the contrary, Wallace believed that natural selection could not explain the origin of human advanced intelligence, and it was after some research on the phenomenon of the deities that Wallace thought he had found reliable evidence for solving this problem.

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