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ALFRED RUSSEL WALLACE, 1823-1913<sup>1</sup>

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**A**LFRID RUSSEL WALLACE, the last survivor of the great group of British naturalists of the nineteenth century, passed away on November 7, 1913, in the ninety-first year of his age and the sixty-fourth year of active service and productiveness. He followed by only a few months another member of the group, Sir Joseph Hooker, who introduced the famous Darwin-Wallace papers on Natural Selection to the Linnæan Society in 1858.

Lyell, Darwin and Wallace were three successive but closely kindred spirits whose work began and ended with what will be known as the second great epoch of evolutionary thought, the first being that of the precursors of Darwin and the third that in which we live. They established evolution through a continued line of attack by precisely similar methods of observation and reasoning over an extremely broad field. As to the closeness of the intellectual sequence between these three men, those who know the original edition of the second volume of "The Principles of Geology," published in 1832, must regard it as the second biologic classic of the century—the first being Lamarck's "Philosophie Zoologique" of 1809—on which Darwin through his higher and much more creative vision built up his "Journal of Researches." When Lyell faltered in the application of his own principles, Darwin went on, and was followed by Wallace.

The two elder men may be considered to have united in guiding the

<sup>1</sup> An abstract of this biographical sketch appeared in *Nature*, Thursday, June 13, 1912, Vol. 89, No. 2224, entitled, "Scientific Worthies. XXXVIII.—Dr. Alfred Russel Wallace, D.C.L., O.M., F.R.S." The writer had the pleasure of receiving a letter from the veteran naturalist June 16, 1912, in which he wrote: "I thank you very much for the complete and careful account of my scientific work and for the great honor you have done me in linking my name with those of Lyell, Darwin and Galton. Your article is by far the best account of my work and of the various influences which determined its direction and the conclusions at which I have arrived. . . ."

mind of Wallace, because the young naturalist, fourteen years the junior of Darwin, took both "The Principles" of Lyell and "The Journal" of Darwin with him on his journey to South America, during which his career fairly began. From his record of observations during his life in the tropics of America and of Asia Wallace will be remembered not only as one of the independent discoverers of the theory of natural selection but next to Darwin as one of the great naturalists of the nineteenth century. His range and originality are astounding in these days of specialization. His main lines of thought, although in many instances suggested to his mind somewhat suddenly, were developed and presented in a deliberate and masterly way through the series of papers and books extending from 1850 to 1913. The highest level of his creative life was, however, reached at the age of thirty-five when with Darwin he published his sketch of the theory of natural selection. This outburst of original thought, on which his reputation will chiefly rest, came as an almost automatic generalization from his twelve years in the tropics.

Nature and nurture conspire to form a naturalist. Predisposition, an opportune period, and a happy series of events favored Alfred Russel Wallace.

Wallace was the son of Thomas Vere Wallace, of Hanworth, Middlesex, England, and Mary Anne Grennell, of Hertford. His ancestry is obscure. On the paternal side he is probably descended from one of the branches of Sir William Wallace, the popular national hero of Scotland, but nothing is known back of his grandfather, who was probably keeper of the inn on the estates of the Dukes of St. Albans, of Hanworth. The burial records of Hanworth mention an Admiral James Wallace. In his mother's family on the paternal side is the name Greenell, of Hertford, probably the "Greenaile" in 1579, French huguenot refugees after the massacre of St. Bartholomew. Her grandfather was for many years alderman and twice mayor of Hertford. One of the Greenells was an architect.

Wallace's father took up the profession of the law, but did not continue, and up to his marriage lived the life of a fairly well to do middle class gentleman. After his marriage he essayed the publishing of two magazines apparently devoted to art, antiquities and general literature, which were failures. He then moved from Marylebone to more rural districts where living was less expensive, first to St. Georges, Southward, and then to Usk, Monmouthshire. In this village Alfred Russel Wallace was born on January 8, 1823.

When about six years of age the family moved to Hertford, and Wallace's education was begun in the old grammar school, which dated back to 1617. He left school too young to begin Greek but he studied Latin, and next to Latin grammar the most painful subject he learned

was geography, principally because of the meaningless way in which it was taught. During the last year of study at the grammar school as the family were then in very straitened circumstances, he assisted in the teaching of the younger boys in reading, arithmetic and writing.

Wallace considered that his home life in Hertford was in many ways more educational than the time spent at school. His father was a man who enjoyed the pleasure of literature, and belonged to a book club through which a constant stream of interesting books came to the house, from which he read aloud to the family in the evenings. The father earned a small income tutoring and as librarian of a small library, and the son Alfred spent hours reading there, also.

At the age of 13 or 14 young Wallace left school, with a view to learning land surveying. He stayed in London a short time with his brother John, who was apprenticed to a master builder, and their evenings were most frequently spent in the "Hall of Science," a kind of mechanics institute for advanced thinkers among workmen. Here he heard many lectures by Robert Owen, the founder of the socialist movement in England, and took up philosophical reading, beginning with Paine's "Age of Reason" among other books. In the summer of 1837 he went with his brother William into Bedfordshire to begin his education as a land surveyor, and practised for seven years in various parts of England and Wales.

After a time it was decided that he should try to pursue the clock-making business as well as surveying and general engineering, and Wallace considered that this was the first of several turning points in his life, because changes in the business of the clock-making concern with which he was connected at Leighton prevented his continuing this work for more than a short period. He was delighted to take up again in 1839 the employment of land surveying because of the opportunities it afforded for out-of-door life.

While at Neath in Wales there was not much demand for surveying, and Wallace occupied himself in constructing a rude telescope with which he was able to observe the moon and Jupiter's satellites, and he developed much interest in studying astronomy and in the development of astronomical instruments. But he says that he was chiefly occupied with what became more and more the solace and delight of his lonely rambles among the moors and mountains, namely, his first introduction to the variety, the beauty and the mystery of nature as manifested in the vegetable kingdom.

His earnings were very meager, and he had little money for the purchase of books. During the seven years he worked with his brother he says he "hardly ever had more than a few shillings for personal expenses." It was during this period while most occupied out of doors with the observation and collection of plants that he began to write

down more or less systematically his ideas on various subjects that interested him. His first literary efforts all bear dates of the autumn and winter of 1843, when he was between nineteen and twenty years of age. One of his first productions was the rough sketch of a popular lecture on botany addressed to an audience supposed to be as ignorant as he was when he began his observation of the native flowers. A second of these early lectures was on the subject "The Advantages of Varied Knowledge," which he considered of interest chiefly as showing the bent of his mind at the time and indicating a disposition for discursive reading and study. He also wrote at this time on the manners and customs of the Welsh peasantry in Brecknockshire and Glamorganshire, and put the matter in form for one of the London magazines, but it was declined.

These early and serious studies in botany, continuing for four years, prepared him for the plant wonders of the tropics. At the age of twenty-one he came to London. He afterward regarded his difficulty in obtaining employment as a great turning point in his career, "for otherwise," he writes, "it seems very unlikely that I should ever have undertaken what at that time seemed rather a wild scheme, a journey to the almost unknown forests of the Amazon in order to observe nature and make a living by collecting."

In his autobiographic volumes of 1905, "My Life, a Record of Events and Opinions," there is also an interesting sketch of his state of mind at this time.

I do not think that at this formative period I could be said to have shown special superiority in any of the higher mental faculties, but I possessed a strong desire to know the causes of things, a great love of beauty in form and color, and a considerable, but not excessive desire for order and arrangement in whatever I had to do. If I had one distinct mental faculty more prominent than another it was the power of correct reasoning from a review of the known facts in any case to the causes or laws which produced them, and also in detecting fallacies in the reasoning of other persons.

Elsewhere in his autobiography he observes that whatever reputation in science, literature and thought he may possess is the result of the organs of comparison, causality and order, with firmness, acquisitiveness, concentrativeness, constructiveness and wonder, all above the average, but none of them excessively developed, combined with a moderate faculty of language which

enables me to express my ideas and conclusions in writing though but imperfectly in speech. I feel, myself, how curiously and persistently these faculties have acted in various combinations to determine my tastes, disposition and actions.

Wallace shared Darwin's strong sentiment for justice as between man and man, and abhorrence of tyranny and unnecessary interference with the liberty of others. His retiring disposition enabled him to enjoy long periods of reflection, receptiveness and solitude, both at home

and in the tropics, out of which have come the sudden illuminations or flashes of light leading to the solution of the problems before him. As to this wonderful mechanism of induction, Wallace observes:

I have long since come to see that no one deserves either praise or blame for the *ideas* that come to him, but only for the *actions* resulting therefrom. Ideas and beliefs are certainly not voluntary acts. They come to us—we hardly know *how* or *whence*, and once they have got possession of us we can not reject or change them at will.

Apart from Darwin's education in Christ's College, Cambridge, as compared with Wallace's self-education, the parallel between his intellectual tendencies and environment and those of Charles Darwin is extraordinary. They enjoyed a similar current of influence from men, from books and from nature. Thus the next turning point in his life was his meeting with Henry Walter Bates, through whom he acquired his zest for the wonders of insect life, which opened for the first time for him the zoological windows of nature. In a measure Bates was to Wallace what the Rev. John S. Henslow had been to Darwin. It is noteworthy that the greater and most original part of his direct observations of nature were upon the adaptations of insects.

Darwin and Wallace fell under the spell of the same books, first and foremost those of Lyell, as noted above, then of Humboldt in his "Personal Narrative" (1814-18), of Robert Chambers in his "Vestiges of the Natural History of Creation" (1844), of Malthus in his "Essay on the Principle of Population" (1798).

It was, however, Darwin's own "Journal of Researches," published in 1845, and read by Wallace at the age of twenty-three, which determined him to invite Bates to accompany him on his journey to the Amazon and Rio Negro, which filled the four years 1848-52. In this wondrous equatorial expanse, like Darwin he was profoundly impressed with the forests, the butterflies and birds, and with his first meeting with man in an absolute state of nature. Bates, himself a naturalist of high order,<sup>2</sup> was closely observing the mimetic resemblances among insects to animate and inanimate objects and introducing Wallace to a field which he subsequently made his own. Bates remained several years after Wallace's departure, and published his classical memoir on mimicry in 1860-61: Wallace's own description of his South American experiences entitled "Narrative of Travels on the Amazon," published in 1853 when he was thirty years of age, does not display the ability of his later writings, and shows that his powers were slowly developing.

His eight years of travel between 1854 and 1862 in the Indo-Malay Islands, the Timor Group, Celebes, the Moluccas and the Papuan Group brought his powers to full maturity. It is apparent that his prolonged observations on the natives, the forests, the birds and mammals, and

<sup>2</sup> See his principal work, entitled "Naturalist on the River Amazons," 2 vols., 8vo, John Murray, London. 1863.

especially on the butterflies and beetles, were gradually storing his mind for one of those discharges of generalization which come so unexpectedly out of the vast accumulation of facts. "The Malay Archipelago" of 1869, published seven years after the return, is Wallace's "journal of researches," that is, it is to be compared with Darwin's great work of this title. Its fine breadth of treatment in anthropology, zoology, botany and physiography gives it a rank second only to Darwin's "Journal" in a class of works repeatedly enriched by British naturalists from the time of Burchell's journey in Africa.

Wallace's first trial at the evolution problem was his essay sent to the *Annals and Magazine of Natural History* in 1855, entitled "On the Law Which has Regulated the Introduction of New Species." This paper suggested the *when* and *where* of the occurrence of new forms, but not the *how*. He concludes:

It has now been shown, though most briefly and imperfectly, how the law that "Every species has come into existence coincident both in time and space with a preexisting closely allied species," connects together and renders intelligible a vast number of independent and hitherto unexplained facts.

In February, 1858, during a period of intermittent fever at Ternate, the *how* arose in his mind with the recollection of the "Essay" of Malthus, and there flashed upon him all the possible effects of the struggle for existence. Twenty years before the same idea, under similar circumstances, had come into the mind of Darwin. The parallel is extraordinary as shown in the following citations:

## DARWIN

In October, 1838, that is, fifteen months after I had begun my systematic inquiry, I happened to read for amusement, "Malthus on Population," and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observations of the habits of animals and plants, it at once struck me that under these circumstances favorable variations would tend to be preserved, and unfavorable ones to be destroyed. *The result of this would be the formation of new species.* Here, then, I had at last got a theory by which to work; but I was so anxious to avoid prejudice that I determined not for some time to write even the briefest sketch of it. In June, 1842, I first allowed myself the satisfaction of writing a very brief abstract of my theory in pencil, in thirty-five pages,

## WALLACE

In February, 1858, I was suffering from a rather severe attack of intermittent fever at Ternate, in the Moluccas; and one day, while lying on my bed during the cold fit, wrapped in blankets, though the thermometer was at 88° Fahr., the problem again presented itself to me, and something led me to think of the "positive checks" described by Malthus in his "Essay on Population," a work I had read several years before, and which had made a deep and permanent impression on my mind. These checks—war, disease, famine and the like—must, it occurred to me, act on animals as well as man. Then I thought of the enormously rapid multiplication of animals, causing these checks to be much more effective in them than in the case of man; and while pondering vaguely on this fact there suddenly

and this was enlarged during the summer of 1844 into one of 230 pages.—Darwin's Autobiography, Chap. II.

flashed upon me the *idea* of the survival of the fittest—that the individuals removed by these checks must be on the whole inferior to those that survived. In the two hours that elapsed before my ague fit was over, I had thought out almost the whole of the theory; and the same evening I sketched the draft of my paper, and in the two succeeding evenings wrote it out in full, and sent it by the next post to Mr. Darwin.—Wallace's "My Life," p. 212.

Darwin had been working upon the verification of the same idea for twenty years. We owe to Sir Joseph Hooker and to Lyell the bringing together of these independent but strikingly similar manuscripts. The noble episode which followed of the joint publication of the discovery was prophetic of the continued care for truth and carelessness of self, of the friendship, mutual admiration and cooperation between these two high-minded men, which affords a golden example for our own and future ages. Each loved his own creations, yet undervalued his own work; each accorded enthusiastic praise to the work of the other.

It is a striking circumstance in the history of biology that Wallace's rapidly produced sketch of 1858 "On the Tendencies of Varieties to Part Indefinitely from the Original Type" not only pursues a line of thought parallel to that of Darwin, except in excluding the analogy of natural with human selection, but embodies the permanent substance of the selection theory as it is to-day after fifty-four years of world-wide research. It may be regarded as his masterpiece. The attempt has been made by De Vries and others to show that Wallace in his "Darwinism" of 1889 differed from Darwin on important points, but whatever may be true of this final modification of the theory, a very careful comparison of the Darwin-Wallace sketches of 1858 shows that they both involve the principle of discontinuity; in fact, fluctuation in the sense of plus and minus variation was not recognized at the time; the notion of variation was that derived directly from field rather than from laboratory notes. This is repeatedly implied in Wallace's language and especially in the concluding sentence of his "Sketch" of 1858:

. . . that there is a general principle in nature which will cause many *varieties* to survive the parent species, and to give rise to successive variations departing further and further from the original type, and which also produces, in domesticated animals, the tendency of varieties to return to the parent form. . . .

Most or perhaps all the variations from the typical form of a species must have some definite effect, however slight, on the habits or capacities of the individuals. Even a change of color might, by rendering them more or less distinguishable, affect their safety; a greater or less development of hair might modify their habits. . . . The superior variety would then alone remain, and on a re-

turn to favorable circumstances would rapidly increase in numbers and occupy the place of the extinct species and variety.

The *variety* would now have replaced the *species*, of which it would be a more perfectly developed and more highly organized form. . . . Here, then, we have *progression and continued divergence* deduced from the general laws which regulate the existence of animals in a state of nature, and from the undisputed fact that varieties do frequently occur. . . . Variations in unimportant parts might also occur, having no perceptible effect on the life-preserving powers; and the varieties so furnished might run a course parallel with the parent species, either giving rise to further variations or returning to the former type. . . . In the wild animal, on the contrary, all its faculties and powers being brought into full action for the necessities of existence, any increase becomes immediately available, is strengthened by exercise, and must even slightly modify the food, the habits and the whole economy of the race. It creates, as it were, a new animal, one of superior powers, and which will necessarily increase in numbers and outlive those inferior to it. . . .

We see, then, that no inferences as to varieties in a state of nature can be deduced from the observation of those occurring among domestic animals. . . . Domestic animals are abnormal, irregular, artificial; they are subject to varieties which never occur and never can occur in a state of nature: their very existence depends altogether on human care; so far are many of them removed from that just proportion of faculties, that true balance of organization . . . will also agree with the peculiar character of the modifications of form and structure which obtain in organized beings—the many lines of divergence from a central type, the increasing efficiency and power of a particular organ through a succession of allied species, and the remarkable persistence of unimportant parts, such as color, texture of plumage and hair, form of horns or crests, through a series of species differing considerably in more essential characters. . . . This progression, by minute steps, in various directions, but always checked and balanced by the necessary conditions, subject to which alone existence can be preserved, may, it is believed, be followed out so as to agree with all the phenomena. . . .

It is true that Wallace subsequently modified his theory, adopted the selection of plus and minus fluctuations, and became a determined opponent of the mutation hypothesis of De Vries.

The distinctive features of the later development of the theory in Wallace's mind were his more implicit faith in selection, his insistence on utility or selection value of new or varying characters, his flat rejection of Lamarckism, his reliance on spontaneous variations as supplying all the materials for selection. This confidence appears in the following passages from his militant reply in the volume of 1889 to the critics of Darwinism:

The right or favorable variations are so frequently present that the unerring power of natural selection never wants materials to work upon. . . . The importance of natural selection as the one invariable and ever-present factor in all organic change and that which can alone have produced the temporary fixity combined with the secular modification of species.

The principle of discontinuity is less clearly brought out than in the first sketch of 1858; the selection of fluctuation is favorably considered. The laws and causes of variation are, however, assumed rather than



taken up as a subject of inquiry. These opinions of 1889 were the summation of twenty-nine years of work.

To return to the life narrative, the autumn of 1860 found Wallace in the Moluccas reading the "Origin of Species" through five or six times, each time with increasing admiration. A letter of September 1 to his friend George Silk contains the key to the subsequent direction of his research, namely, his recognition of the vast breadth of Darwin's principles and his determination to devote his life to their exposition:

I could *never have approached* the completeness of his book, its vast accumulation of evidence, its overwhelming argument, and its admirable tone and spirit. I really feel thankful that it has *not* been left to me to give the theory to the world. Mr. Darwin has created a new science and a new philosophy; and I believe that never has such a complete illustration of a new branch of human knowledge been due to the labors and researches of a single man. Never have such vast masses of widely scattered and hitherto quite unconnected facts been combined into a system and brought to bear upon the establishment of such a grand and new and simple philosophy.

The discovery of "Natural Selection" again turned the course of Wallace's life. In his autobiography he writes:

I had, in fact, been bitten with the passion for species and their description, and if neither Darwin nor myself had hit upon "natural selection," I might have spent the best years of my life in this comparatively profitless work, but the new ideas swept all this away. . . . This outline of the paper will perhaps enable my readers to understand the intense interest I felt in working out all these strange phenomena, and showing how they could almost all be explained by that law of "Natural Selection" which Darwin had discovered many years before, and which I also had been so fortunate as to hit upon.

The coloring of animals as observed in the tropics and the Malayan Islands was the subject in which Wallace made his most extensive and original contributions to Darwinism. In his "Sketch" of 1858-9 he wrote:

Even the peculiar colors of many animals, especially insects, so closely resembling the soil or the leaves or the trunks on which they habitually reside, are explained on the same principle; for though in the course of ages varieties of many tints may have occurred, *yet those races having colors best adapted to concealment from their enemies would inevitably survive the longest.*

Returning from the Archipelago in 1862, he published in 1864 his pioneer paper, "The Malayan Papilionidæ or Swallow-tailed Butterflies, as illustrative of the Theory of Natural Selection," in which he at once took rank beside Bates and Müller as one of the great contributors to the color characteristics of animals. We see him step by step developing the ideas of protective resemblance which he had fully discussed with Bates, of alluring and warning colors, and of mimicry, pointing out the prevalence of mimicry in the female rather than in the male. The whole series of phenomena are believed to depend upon the great principle of the utility of every character, upon the need of color protection by almost all animals, and upon the known fact that no characteristic is so

variable as color, that, therefore, concealment is most easily obtained by color modification. Protective resemblance in all its manifold forms has ever been dominant in his mind as a greater principle than that of the sexual selection of color which Darwin favored.

Here may be cited Wallace's own account of his famous observation of mimicry in the leaf butterfly from his volume of 1869, "The Malay Archipelago":

The other species to which I have to direct attention is the *Kallima paralekta*, a butterfly of the same family group as our Purple Emperor, and of about the same size or larger. Its upper surface is of a rich purple, variously tinged with ash color, and across the fore wings there is a broad bar of deep orange, so that when on the wing it is very conspicuous. This species was not uncommon in dry woods and thickets, and I often endeavored to capture it without success, for after flying a short distance it would enter a bush among dry or dead leaves, and however carefully I crept up to the spot I could never discover it till it would suddenly start out again and then disappear in a similar place. At length I was fortunate enough to see the exact spot where the butterfly settled, and though I lost sight of it for some time, I at length discovered that it was close before my eyes, but that in its position of repose it so closely resembled a dead leaf attached to a twig as almost certainly to deceive the eye even when gazing full upon it. I captured several specimens on the wing, and was able fully to understand the way in which this wonderful resemblance is produced. . . . All these varied details combine to produce a disguise that is so complete and marvellous as to astonish every one who observes it; and the habits of the insects are such as to utilize all these peculiarities, and render them available in such a manner as to remove all doubt of the purpose of this singular case of mimicry, which is undoubtedly a protection to the insect.

In 1867, in a manner which delighted Darwin, Wallace advanced his provisional solution of the cause of the gay and even gaudy colors of caterpillars as warnings of distastefulness. In 1868 he propounded his explanation of the colors of nesting birds, that when both sexes are conspicuously colored, the nest conceals the sitting bird, but when the male is conspicuously colored and the nest is open to view, the female is plainly colored and inconspicuous. His theory of recognition colors as of importance in enabling the young of birds and mammals to find their parents was set forth in 1878, and he came to regard it as of very great importance.

In "Tropical Nature" (1878) the whole subject of the colors of animals in relation to natural and sexual selection is reviewed, and the general principle is brought out that the exquisite beauty and variety of insect colors has not been developed through their own visual perceptions, but mainly and perhaps exclusively through those of the higher animals which prey upon them. This conception of color origin, rather than that of the general influence of solar light and heat or the special action of any form of environment, leads him to his functional and biological classification of the colors of living organisms into five groups, which forms the foundation of the modern more extensive and critical classification of Poulton. He concluded (p. 172):

We find, then, that neither the general influence of solar light and heat, nor the special action of variously tinted rays, are adequate causes for the wonderful variety, intensity and complexity of the colors that everywhere meet us in the animal and vegetable worlds. Let us, therefore, take a wider view of these colors, grouping them into classes determined by what we know of their actual uses or special relations to the habits of their possessors. This, which may be termed the functional and biological classification of the colors of living organisms, seems to be best expressed by a division into five groups, as follows:

Animals.	}	1. Protective colors.	} a. Of creatures specially protected. b. Of defenceless creatures, mimicking a.
		2. Warning colors.	
		3. Sexual colors.	
		4. Typical colors.	
Plants.		5. Attractive colors.	

Twelve years later he devoted four chapters of his "Darwinism" to the colors of animals and plants, still maintaining the hypotheses of utility, of spontaneous variation and of selection.

The study of geographic distribution of animals also sprang from the inspiration of the Malayan journey and from the suggestiveness of the eleventh and twelfth chapters of "The Origin of Species" which Wallace determined to work out in an exhaustive manner. Following the preliminary treatises of Buffon, of Cuvier and Forbes, and the early regional classification of Sclater, Wallace takes rank as the founder of the science of zoogeography in his two great works, "The Geographical Distribution of Animals" of 1876, and "Island Life" of 1881, the latter volume following the first as the result of four years of additional thought and research. His early observations on insular distribution were sketched out in his article of 1860, "The Zoological Geography of the Malayan Archipelago."

Here is his discovery of the Bali-Lombok boundary line between the Indian and the Australian zoological regions which has since been generally known by his name.

In these fundamental geologic and geographic works Wallace appears as a disciple of Lyell in uniformitarianism, and a follower of Dana as regards the stability and permanence of continental and oceanic areas, for which doctrine he advances much original evidence. He taxes his ingenuity to discover every possible means of dispersal of animals and plants other than those which would be afforded by hypothetical land connections; he considers every possible cause of extinction other than those which are sudden or cataclysmal.

The "Island Life" is in itself a great contribution to zoology and zoogeography, the starting point of all modern discussion of insular faunas and floras. His conservative theory of dispersal is applied in an original way to explain the arctic element in the mountain regions of the tropics, as opposed to the low-temperature theory of tropical lowlands during the Glacial Period; his explanation is founded on known facts as to the dispersal and distribution of plants, and does not require the

extreme changes in the climate of tropical lowlands during the Glacial Period on which Darwin founded his interpretation. The causes and influence of the Glacial Epoch are discussed in an exposition of Croll's theory. In this connection may be mentioned one of Wallace's original geological contributions, in the article "Glacial Erosions of Lake Basins," published in 1893, namely, his theory of glacial erosion as a means of explaining the origin of valley lakes of glaciated countries.

The original trend of Wallace's thought as to the ascent of man is first shown in the three anthropological essays of 1864, 1869 and 1870, which were subsequently collected in the volume "Contributions to the Theory of Natural Selection." This work, published in 1871, includes all his original essays from 1855 to 1869 on selection, on color and human evolution, which foreshadow the later development of his speculative philosophy.

A suggestive anthropological contribution is the article entitled "The Expressiveness of Speech or Mouth Gesture as a Factor in the Origin of Language," in which is developed the theory of the origin of language in connection with the motions of the lips, jaws and tongue. With Wallace also arose the now widely accepted belief that the Australian aborigines constitute a low and perhaps primitive type of the Caucasian race.

In the article of 1864, "The Development of Human Races under the Law of Natural Selection," Wallace first advanced the hypothesis which has since proved to be untenable that so soon as man learned to use fire and make tools, to grow food, to domesticate animals, to use clothing and build houses, the action of natural selection was diverted from his body to his mind, and thenceforth his physical form remained stable, while his mental faculties improved. His subsequent papers on human evolution, "The Limits of Natural Selection as Applied to Man" of 1869, "On Instinct in Man and Animals" of 1871, mark the gradual divergence of his views from those of Darwin, for in his opinion natural selection is believed to be inadequate to account for several of the physical as well as psychical characteristics of man, for example his soft, sensitive skin, his speech, his color sense, his mathematical, musical and moral attributes. He concluded:

The inference I would draw from this class of phenomena is that a superior intelligence has guided the development of man in a definite direction, and for a special purpose, just as man guides the development of many animal and vegetable forms.

It is also prophetic of his later indictments of the so-called civilization of our times that we find at the end of the closing pages of "The Malay Archipelago" the first statement of the feeling which so many travellers have experienced from a comparison of the natural and so-called civilized condition of man that "social evolution from barbarism

to civilization" has not advanced general human welfare. These humanitarian and partly socialistic ideas are developed in a series of recurrent essays between 1882 and 1903, including "The Nationalization of Land," and "Studies Scientific and Social."

He returned to this subject in what we believe to be his last published essay, namely, his "Social Environment and Moral Progress" of 1913, wherein he considers the so-called "feministic" movement and future of woman:

The foregoing statement of the effect of established natural laws, if allowed free play under rational conditions of civilization, clearly indicates that the position of woman in the not distant future will be far higher and more important than any which has been claimed for or by her in the past.

While she will be conceded full political and social rights on an equality with men, she will be placed in a position of responsibility and power which will render her his superior, since the future moral progress of the race will so largely depend upon her free choice in marriage. As time goes on, and she acquires more and more economic independence, *that* alone will give her an effective choice which she has never had before. But this choice will be further strengthened by the fact that, with ever-increasing approach to equality of opportunity for every child born in our country, that terrible excess of male deaths, in boyhood and early manhood especially due to various preventable causes, will disappear, and change the present majority of women to a majority of men. This will lead to a greater rivalry for wives, and will give to women the power of rejecting all the lower types of character among their suitors.

It will be their special duty so to mould public opinion, through home training and social influence, as to render the women of the future the regenerators of the entire human race.

In closing this review of a great life, we can not refrain from reflecting on the pendulum of scientific opinion. The discovery of a great truth such as the law of Selection is always followed by an over-valuation, from which there is certain to be a reaction. We are in the midst of such a reaction at the present time, in which the Darwin-Wallace theory of natural selection is less appreciated than it will be in the future when there comes a fresh readjustment of scientific values.

It is well to remember that we may not estimate either the man of science or his conclusions as of our own period, but must project ourselves in imagination into the beginnings of his thought and into the travails of his mind, considering how much larger he was than the men about him, how far he was an innovator, breaking away from the traditions of his times, how far his direct observations apart from theory are true and permanent, and how far his theories have contributed to the great stream of biological thought.

Our perspective has covered a long, honorable span of sixty-five years into the beginnings of the thinking life of a natural philosopher whose last volume, "The World of Life," of the year 1911, gives as clear a portrayal of his final opinions as that which his first essay of 1858 portrays of his early opinions.

We follow the cycle of his reflection beginning with "adaptation" as the great mystery to be solved; in the middle and sanguine period of life, "adaptation" is regarded as fully explained by natural selection; in the closing and conservative period of life "adaptation" is again regarded in some of its phases as entirely beyond human powers of interpretation, not only in the evolution of the mental and spiritual nature of man, but in such marvelous manifestations as the scales of butterflies or the wings of birds.

From our own intellectual experience we may sympathize with the rebound of maturity from the buoyant confidence of the young man of thirty-five who finds in natural selection the entire solution of the problem of fitness which has vexed the mind and aroused the scientific curiosity of man since the time of Empedocles. We have ourselves experienced a loss of confidence with advancing years, an increasing humility in the face of transformations which become more and more mysterious the more we study them, although we may not join with this master in his appeal to an organizing and directing supernatural principle. Younger men than Wallace, both among the zoologists and philosophers of our own time are giving a somewhat similar metaphysical solution of the eternal problem of adaptation, which still baffles and transcends our powers of experiment and of reasoning.

LIST OF BOOKS OF ALFRED RUSSEL WALLACE, O.M., F.R.S., ETC.

Sent to the author of the present article in a letter of May 3, 1912.

"In accordance with your request I herewith send you a list of my published books. The delay has been caused by the only complete copy I had having been sent away for publication.

"I have always intended to make out a complete list of my various communications to periodical literature, but have hitherto been unable to find time to do so. All my scientific communications, however, will be found in the *Royal Society's* Catalogue of Scientific Papers which no doubt you have access to."

1. "Palm Trees of the Amazon and their Uses." Pub. 1853.
2. "A Narrative of Travels on the Amazon and Rio Negro, with an Account of the Native Tribes and Observations on the Climate, Geology and Natural History of the Amazon Valley." Pub. 1853, new edition 1889.
3. "The Malay Archipelago, the Land of the Orang-utan and the Bird of Paradise. A Narrative of Travel with Studies of Man and Nature." First edition 1869 (2 vols.). Tenth edition 1898 (1 vol.).
4. "Contributions to the Theory of Natural Selection." Pub. as single vol. 1870. Pub. with "Tropical Nature" in 1 vol. 1891.
5. "Miracles and Modern Spiritualism." Pub. 1874. Revised edition 1896.
6. "The Geographical Distribution of Animals, with a Study of the Relation of Living and Extinct Faunas as Elucidating the Past Changes of the Earth's Surface." Pub. 1876 (2 vols.).
7. "Tropical Nature and Other Essays." Pub. 1 vol. 1878. Pub. with "Natural Selection" in 1 vol. 1891.
8. "Australasia." Stanford's Compendium of Geography and Travel. Pub. 1879, 3d edition 1883. New edition 1893, 1st vol., "Australia and New Zealand."

9. "Island Life or the Phenomena and Causes of Insular Faunas and Floras, including a Revision and Attempted Solution of the Problem of Geological Climates." Pub. 1880. Third and revised edition 1902.
10. "Land Nationalization, its Necessity and its Aims; being a Comparison of the System of Landlord and Tenant with that of Occupying Ownership in their Influence on the Well-being of the People." Pub. 1882.
11. "Bad Times. An Essay on the Present Depression of Trade, Tracing it to its Sources in Enormous Foreign Loans, Excessive War Expenditure, the Increase of Speculation and of Millionaires, and the Depopulation of the Rural Districts; with Suggested Remedies." Pub. 1885.
12. "Darwinism. An Exposition of the Theory of Natural Selection with Some of its Applications." Pub. 1889.
13. "The Wonderful Century. The Age of New Ideas in Science and Invention." Pub. 1898. New ed. revised and largely rewritten 1903.
14. "The Wonderful Century Reader." Pub. 1901.
15. "Studies, Scientific and Social." 2 vols. Pub. 1900.
16. "Man's Place in the Universe. A Study of the Results of Scientific Research in Relation to the Unity or Plurality of Worlds." Pub. 1903. Fourth ed. 1904 (revised).
17. "Is Mars Habitable? A Critical Examination of Professor Percival Lowell's Book 'Mars and its Canals,' with an Alternative Explanation." Pub. 1907.
18. "My Life, a Record of Events and Opinions." Pub. 2 vols. 1905. New ed., 1 vol., revised 1908.
19. "Notes of a Botanist on the Amazon and Andes, being Records of Travel on the Amazon and its Tributaries, the Trombetes, Rio Negro, Napis, Casiquari, Pacimoni, Huallaga and Pastasa; as also to the Cataracts of the Orinoco, along the Eastern Side of the Andes of Peru and Ecuador, and the Shores of the Pacific, during the years 1849-64." By Richard Spruce, Ph.D., edited and condensed by Alfred Russel Wallace, O.M., F.R.S., etc., with a biographical introduction, portrait, illustrations and maps. 2 vols. Pub. 1908.
20. "The World of Life, a Manifestation of Creative Power, Directive Mind and Ultimate Purpose." Pub. 1910.

*The Royal Society Catalogue of Scientific Papers*, covering the years 1800-1883, lists ninety-five papers and books by Wallace, the first dated 1850, and his subsequent communications will be found in *The Zoological Record* and *The International Catalogue of Scientific Literature*, which cover the field from the time the *Royal Society Catalogue* ceased.