Butterfly Hunter: The Life of Henry Walter Bates.

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Source: The Journal of the Lepidopterists' Society, 66(2) : 116-118

Published By: The Lepidopterists' Society

URL: https://doi.org/10.18473/lepi.v66i2.a7

Journal of the Lepidopterists' Society
66(2), 2012, p.116–118

BUTTERFLY HUNTER: THE LIFE OF HENRY WALTER BATES. By Anthony Crawforth. 272 pp. Hardbound; ISBN 9780956071613. About $54 from online sources. University of Buckingham Press. Buckingham UK. 2009.

The power of today's molecular technology to dissect nature sometimes overwhelms the history of discovery in biology. This new book by Anthony Crawforth helps put the Bates back into Batesian mimicry and will be a welcome resource to better understand the importance of Henry W. Bates' work on mimicry in butterflies and his contributions to evolutionary theory.

Crawforth, an amateur lepidopterist, has an MA in museum management and a PhD in Biography from the University of Buckingham. With this background, he and his son retraced Bates' travels in the Amazon where Crawforth collected materials and impressions for this book. The author believes that Bates, in spite of his friendship and professional association with Wallace and Darwin, is relatively unknown and his contributions to evolutionary theory not fully appreciated outside a small circle of evolutionary biologists. This book is a biography of a scientist whose discovery and elucidation of mimicry in Lepidoptera was historically important. Its strength is in its extensive biographical material and it isn't intended to be either a natural history of the Amazon region nor a popular science treatment of mimicry in Lepidoptera.

The book is divided into three parts: Early Development, The Evolution of the Naturalist, and The Evolution of the Man. Following chapters on Bates' early life, the book details his eleven year exploration, jointly at first with Wallace, of the vast, primitive and at times dangerous Amazon Basin. Eight plates are included of paintings Bates had done based on his memory of collecting specimens, boat travel on the Amazon, social gatherings in villages, etc. Other reproductions are sprinkled in the text, including a whimsical sketch —"Incident with Toucans"— of a befuddled Bates being mobbed by them after capturing one of their number. In addition to a bibliography and literature citations, there are four appendices: Bates' butterflies (including reproductions of his color plates), awards and medals, a chronology of Bates' time with the Royal Geographical Society, and details of his family life post-Amazon.

Butterfly Hunter documents Bates' three main contributions: 1) Bates published numerous professional articles and a best-selling book describing his travels and the extraordinary richness of the Amazon biota (reprinted as Clodd, 1892), 2) He added immensely to the collections of British Museum of Natural History, especially in insects and in particular butterflies, 3) Bates discovered a striking resemblance among certain unrelated butterflies in Amazonia. On return to England he was stimulated by Darwin's newly published *Origin of Species*, and with contributions from Wallace formulated his theory of mimicry, which Darwin in turn embraced as crucial evidence for natural selection in the wild.

I particularly enjoyed reading Crawford's introductory material describing converging life stories of Wallace, Bates, and others who contributed to Darwin's synthesis in *On the Origin of Species*. Bates met Alfred Russel Wallace when both were college students in England. They shared an interest in natural history and were intrigued by the mystery of the origin of species. The two men hatched an idealistic scheme to travel to Brazil, to be funded by collecting specimens to be shipped back to England and sold to museums and private collectors. The catalyst that fueled their enthusiasm and fixed the Amazon basin as their goal was the 1846 book by the American Lepidopterist William Henry Edwards: *A Voyage up the River Amazon: Including a Residence at Para*.

Landing at Belém (then Pará) on 28 May, 1848, they collected and explored together until October. They were aided by letters of introduction, including William Henry Edwards, yet found the traveling and collecting unexpectedly arduous. It was perhaps inevitable that a split between Bates and Wallace occurred early on, probably a rift between two strong-willed intellects, in spite of their shared devotion to natural history. Bates persevered alone, befriending land-owners for lodging and recruiting locals as field assistants. Bates' record of discovery and exploration is indeed impressive. He spent four of the eleven years in the vicinity of Tefé, an inland community along the Upper Amazon, where he collected an incredible 7000 insect specimens, 3000 new to science including 550 new butterfly species! Of the 14,712 animal specimens he brought back to England, 8000 were new to science.

The severe class-consciousness and puritanical social mores that characterized Victorian England are central themes in Crawford's historical narrative. Bates was fascinated by the mix of Portuguese, other Europeans, black slaves and the many tribes of indigenous people he met in the Amazon, and uncritical of their commonplace intermarriage. He was a keen observer of

various tribes, employing many as aides in collecting and preparing specimens, and in some cases developing enduring personal friendships. Crawforth offers evidence that Bates may have fathered a daughter from one liaison, who tragically died during his stay in the Amazon. These cross-cultural experiences were in stark contrast to Bates' reception upon returning to England.

Crawforth pointedly describes the hypocrisy of British society in not fully accepting Bates into the social structure of preeminent scientists, probably due to his origins as a tradesman (stocking manufacturing) and lack of "proper" schooling. In spite of his reputation gained from his well-documented collections and his publications, Bates was not given a position as curator of entomology at the British Natural History Museum. He was passed over in favor of an administrator's crony with no entomology background over the protests of Darwin and members of the Royal Entomological Society. Indeed, science as a profession had not yet fully achieved parity with other professions and was looked down upon by the Museum trustees, who funded the yearly budget for insect collecting at only £10! I found Crawforth's sociological discussion fascinating, with his use of Bates' Amazon experience as a foil to that encountered in contemporary England upon his return.

With support from Darwin and others, Bates was eventually elected as Secretary to the Royal Geographical Society where he successfully developed a life-long career. During this period he published his book and many scientific papers, but never again returned to collecting or original research of any kind. In his summary chapter, Crawforth proposes that Bates experienced "distress or great disappointment" upon returning to England and taking up a new career, and that he coped with this "unbearable event" by taking on a new post-Brazil personality, with "workaholic tendencies … reaching the optimum in achievements or self-actualising …". I found little support in *Butterfly Hunter* for any such dramatic change in personality, nor in the concise biography by O'Hara (1995) who describes Bates as both successful in his new career while at the same time actively publishing his Amazon work.

The author's explanation of mimicry, and its basis in behavior, genetics, and physiology is less satisfying than the biographical material. About ten pages are devoted to the topic, including Bates' discovery of mimicry by pierids of model species in the Ithomiinae, and of the formulation by Fritz Müller of shared mimicry among unrelated distasteful species, known as Müllerian mimicry. Crawforth cites his personal experiences with the African *Papilio dardanus* mimicry system, and includes a plate of adults, but Bates' example species are treated in a single plate at the end of the book, separate from the relevant text. The specimen numbers given in the plate legend are not repeated in the plate, making species identification ambiguous at best. Clark and Sheppard studies with *Papilio dardanus* and *P. glaucus* are discussed, but the explanation of hybridization as a means to demonstrate a mimicry "supergene" is superficial. Mimicry in nature would be a useless gesture if memory did not guide predation. The studies of the Browers (1958) demonstrating the learned ability of birds to avoid the model monarch and mimic viceroy should have been cited. A reader of Crawforth's book might gain the mistaken impression that the study of mimicry genetics ended with the *P. dardanus* work. Not mentioned are the many population genetics studies of mimicry systems, using DNA technology, such as by James Mallet (University College London) or Larry Gilbert (University of Texas, Austin) on hybrid zones between mimetic forms in *Heliconius*.

An important theme in Crawforth's book is that Bates has historically not been fully recognized for his contributions to evolutionary biology. An anecdote concerning mimetic butterflies, as an example of natural selection in the wild, supports this view. In the early twentieth century genetics was maturing as a science, and skepticism remained toward Darwinism. The anti-selection camp was headed by the geneticist T. H. Morgan, of Columbia University, who insisted that dramatic change through mutation, not natural selection on innate variation, was the mechanism of evolution. Taken by Julian Huxley to see the impressive collection of mimetic butterflies at Oxford, "Morgan left the exhibit quite shaken. He said: 'This is extraordinary. I just didn't know that things like this existed.' By the end of his life Morgan had become reconciled to the possibility that Darwin might have something after all." (Edey and Johanson 1989, pp. 169-170).

It wasn't until the evolutionary synthesis of genetics, systematics and ecology that the significance of Batesian mimicry was understood. Fisher, in his seminal "Genetical Theory of Natural Selection" (1930) mentions Bates and mimicry, yet Dobzhansky (1951) only devotes a few pages to the subject. The words "Bates" and "mimicry" are not found in the index of Gould's (2002) treatise on evolutionary theory. On the other hand, Mayr (1963) cites Bates' observation on geographic variation and the importance of physical barriers in isolating closely related species, but notes that neither Bates nor Wallace developed their observations into a coherent theory of geographic speciation. The genetic basis and ecological operation of mimicry is routinely discussed in text books, but the influence of Bates is often ignored in favor of Darwin and Wallace.

As discussed by O'Hara (1995), but not by Crawforth, Bates should also be remembered for his contributions to biogeography, in the form of insightful speculation included in his taxonomic papers, often citing the likely role of glaciation in dispersal and speciation.

I have only minor criticisms on the production and organization of *Butterfly Hunter*. Crawforth devotes just a single chapter to his own travels in Amazonia. This is disappointing as his writing is personal, vivid and entertaining. He describes and identifies birds, mammals and butterflies he encountered on rain forest trails, and intersperses his own narrative with quotes from Bates' writings on the same region. Citations are given as numbered footnotes in very small typeset, but not all are included in the selected references which are listed, without spacing or indentation, at the end of the book. Certain proper names are listed by first name in the index. Finding a specific citation can be difficult. Otherwise the production is first-rate, printed on quality paper with a dark, high contrast ink. I recommend *Butterfly Hunter*, not just to Lepidopterists, but to anyone interested in natural history and the history of science.

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