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Editorial Article Open Access

Two Pioneering Darwinians in Brazil: An Appraisal of Henry Walter Bates (1825-1892) and Fritz M ü ller (1821-1897)

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Editorial

Exactly 170 years ago (May 26th, 1848), Henry Walter Bates and his friend Alfred Russel Wallace arrived in Salinas, Brazil, the pilot-station for vessels bound to Pará, the port of entry to the almost unexplored Amazon basin [1,2]. Some four years later (July 21st, 1852) the young German naturalist Johannes Friedrixh ("Fritz") Müller disembarked at San Francisco, Santa Catarina, about 120 km of his final destination, the German colony of Blumenau [3,4]. After parting with Wallace in 1852 who returned to England in an ill-fated voyage [5] Bates stayed for seven more years exploring the Amazon basin. Facing perils and disease [1-8]. Instead, Müller stayed the rest of his life in Blumenau exploring the fauna and flora of Santa Catarina's forests, rivers and Atlantic coast until his death at 76 years old [3,4]. Both man, Bates a self-taught naturalist, and Müller with degrees in Pharmacy and Medicine, were ardent explorers and lovers of the luxuriant Brazilian forests and their unique biodiversity. Bates returned to England in 1859 [1,2], the year of the publication of the most famous and influential book in biology, The Origin of Species by Charles Darwin [9] while Müller received a copy of the book in 1861 [4]. Both naturalists were immediately convinced of Darwin's ideas about natural selection and descent with modification (evolution) which could explain a number of puzzling facts they had found in their research of animal species.

Müller and Bates became great friends of Darwin who admired them both and always praised their fundamental contributions to his theory of natural selection. Their respective correspondences were prolific and in both cases lasted until the death of the great master in 1882 [10-12]. Darwin called Müller 'the prince of observers' and consulted Bates on the minutest entomological matters. Bates was essentially an entomologist who collected almost 15,000 specimens in Amazonia, most of them insects [2,6,7]. He was an expert taxonomist of Coleoptera, Lepidoptera, and Phasmatodea describing hundreds of new species [13]. Müller had wider interests in animals and plants although insects were primary research subjects for him specializing in Lepidoptera, Hymenoptera, and Isoptera to which he devoted many of his 274 publications [14].

Charles Darwin expressed his appreciation and admiration for these two great naturalists not only because they were expert and serious scientists and kind gentlemen, but because substantial parts of their research became fundamental proof and support of his (and Wallace's) theory of natural selection. This work involved the elucidation of the puzzling and complex phenomenon of mimicry [15-20]. Bates made numerous and perceptive observations on Amazonian rainforest butterflies of the subfamilies Ithoninae and Heliconinae (Nymphalidae) which led him to propose that the striking morphological resemblance between species not even closly related, could be due to the protection against predators gained by a palatable species by becoming similar to an unpalatable or unprofitable species [21]. This phenomenon is today called "Batesian mimicry" [19,20,22]. In this evolutionary mechanism the imitating species is the mimic, and the unpalatable or venomous species is the model. The predator that mediates the interaction is the dupe or signal receiver which, upon learning to avoid the model, makes the mimic gain an evolutionary advantage [18-22]. Bates's model was hailed by Darwin and Wallace as an extraordinary discovery and one of the best proofs of the theory of natural selection [10,23,24].

However, Bates was puzzled by cases where an unpalatable species resembled another one also toxic to predators advancing the explanation that rare harmful species could benefit from resembling more common unpalatable ones, but also that the similarity could result from "pseudomimicry" [22,25]. The solution was provided by Fritz Müller who first advanced a number of possible but unsatisfactory solutions-some based in the theory of sexual selection-in letters to Darwin [12,26]. He came to the fruitful model now called "Müllerian mimicry" in a short paper published in 1878 [27], later expanded in a 1879 article published in German but quickly translated to English by Raphael Meldola owing to its relevance to evolutionary theory [28]. He not only produced a new hypothesis to explain the resemblance between unprofitable species but he also developed the first mathematical model in evolutionary ecology to explain this complex process based on natural selection. This model (Müller's number-dependent or strength-in-numbers model) was based on frequency dependent natural selection [28-30] it essentially postulates that when two or more unpalatable species mimic each other, the cost of learning (to avoid this kind of prey) by the predator, will be shared by all prey species which always leads to favourable and mutualistic gains for all prey species [29,30].

These two extraordinary scientists, the Prince of Observers and the Butterfly Hunter, were early staunch Darwinians that not only produced incredibly valuable support to the theory of natural selection but gave birth to a new one, the theory of mimicry which today is a very active research field in multiple model organisms [19,31]. Both co-founders of the modern evolutionary theory praised these two notable naturalists and explorers. Darwin said of Bates' work: "Mr. Bates has given to these facts the requisite touch of genius, and has, we cannot doubt, hit on the final cause of all this mimicry" [23]. And Wallace commented on Müller's model: "The merit of the discovery is wholly due to Dr. Fritz Müller" [32].

May all biologists follow their steps.

References

1. Bates HW (1910) The Naturalist on the River Amazons. Vols. I & II. London, John Murray.
2. Crawforth A (2009) The Butterfly Hunter: The Life of Henry Walter Bates. Buckingham, University of Buckingham Press.
3. Möller A (1920) Fritz Müller. Werke, Briefe und Leben. Vol. 3. Leben. Jena, Verlag von Gustav Fischer.
4. West DA (2009) Darwin´s Man in Brazil: The Evolving Science of Fritz Müller. Gainesville, University Press of Florida.
5. Shermer M (2002) In Darwin´s Shadow: The Life and Science of Alfred Russel Wallace. Oxford, Oxford University Press.
6. Dickenson J (1992) The Naturalist on the river Amazon and a wider world: reflections on the centenary of Henry Walter Bates. The Gepgraphical Journal 158: 207-214.
7. Van Wyhe J (2013) A delicate adjustment: Wallace and Bates on the Amazon and "The Problem of the Origin of Species". J Hist Biol 47: 627-659.
8. Ferreira RdS (2004) Henry Walter Bates: Um viajante naturalista na Amazônia e o process de transferência da informação. Ciên Inf 33: 67-72.
9. Darwin C (1859) The Origin of Species. London, John Murray.
10. Bidau CJ (2014) The katydid that was: the tananá, stridulation, Henry Walter Bates and Charles Darwin. Arch Nat Hist 41: 131-140.
11. Stecher RM (1969) The Darwin-Bates letters. Correspondence between two nineteenth-century travellers and naturalists. Parts I and II. Ann Sci 25: 95-125.
12. Möller A (1921) Fritz Müller. Werke, Briefe und Leben. Vol. 2. Briefe 1854-1897. Jena, Verlag von Gustav Fischer.
13. Bragg PE (2007) Biographies of phasmatologists. I. Henry Walter Bates-Phasmid Stud 15: 1-4.
14. Möller A (1915) Fritz Müller. Werke, Briefe und Leben. Vol. 2. Werke. Jena, Verlag von Gustav Fischer.
15. Vane-Wright RI (1976) A unified classification of mimetic resemblamces. Biol J Linn Soc 8: 25-56.
16. Vane-Wright RI (1980) On the definition of mimicry. Biol J Linn Soc 13: 1-6.
17. Joron M, Mallet JLB (1998) Diversity in mimicry: Paradox or paradigm? Trends Ecol Evol 13: 461-466.
18. Mallet JLB, Joron M (1999) Evolution of diversity in warning color and mimicry: Polymorphisms, shifting balance, and speciation. Annu Rev Ecol Syst 30: 202-230.
19. Ruxton GD, Sherratt TN, Speed MP (2004) Avoiding Attack: The Evolutionary Ecology of Crypsis, Warning Signals, and Mimicry. Oxford, Oxford University Press.
20. Larson A (2009) Adaptation. In: The Princeton Guide to Ecology (Levin SE, ed). Princeton, Princeton University press. Pp: 93-100.
21. Bates HW (1852) Contributions t an insect fauna of the Amazon valley. Lepidoptera: Heliconidae. Trans Linn Soc Lond 23: 495-566.
22. Sherratt TN (2008) The evolution of Müllerian mimicry. Naturwissenscften 95: 681-695.
23. Darwin C (1863) Contributions to an insect fauna of the Amazon valley. By Henry Walter Bates, Esq. Trans. Linn. Soc. Lond. XXIII. Natural History Review 3: 219-224.
24. Wallace AR (1867) Mimicry, and other protective resemblances among animals. Westminster Rev. 32: 1-43.
25. Grobman AB (1978) An alternative solution to the coral snake mimic problem. J Hepetol 12: 1-11.
26. Poulton EB (1909) The values of colour in the stuggle for life. In: Darwin and Modern Science: Essays in the Commemoration of the Centenary of the Birth of Charles Darwin and the fifitieth Anniversary of the Publication of the Origin of Species (Seward AC, ed). Cambridge, Cambridge University Press. Pp: 207-227.
27. Müller F (1878) Über die vortheille dermimicry bei schmetterlingen. Zool. Anz 1: 54-55.
28. Müller F (1879) Ituna and Thyridia: a remarkable case of mimicry in butterflies. Proc Entomol Soc Lond 1879: 20-24.
29. Mallet J (2001) Mimicry: an interface between psychology and evolution. Proc Nat Acad Sci. USA 98: 8928-8930.
30. Ferreira WC, Marcon D (2014) Revisiting the 1879 model for evolutionary mimicry by Fritz Müller: new mathematical approaches. Ecol Complex. 18: 25-38.
31. Wickler W (1968) Mimicry in Plants and Animals. New York, MacGraw-Hill.
32. Wallace AR (1882) Dr. Fritz Müller on some difficult cases of mimicry. Nature 26: 86-87.