The Entomological Society of Manitoba

Newsletter

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About the ESM Newsletter

The Entomological Society of Manitoba Newsletter is published three times per year. It is a forum whereby information can be disseminated to Society members. As such, all members are encouraged to contribute often. The Newsletter is interested in opinions, short articles, news of research projects, meeting announcements, workshops, courses and other events, requests for materials or information, news of personnel or visiting scientists, literature reviews or announcements and anything that may be of interest to ESM members.

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Editors' Comments

Mark your calendars – the upcoming 72nd **Annual Meeting of the Entomological Society of Manitoba** is being held on Friday and Saturday, 28 and 29 October 2016. There is a notice with details in this issue.

When we think of **Darwin**, entomology is not usually the first association that comes to mind but he was an avid collector, and there are many references to insects throughout his writings and correspondence. **Bob Wrigley** introduces us to Darwin the entomologist, providing a compilation of many references, accompanied by photos from Bob's own insect collection.

Marjorie Smith & Jordan Bannerman

President's Message

Meetings big and small

It is still hot outside, but many of our members are turning their eyes to the fall meetings in Orlando FL for the International Congress of Entomology, and our own slightly smaller meeting of the 72nd Annual Meeting of the Entomological Society of Manitoba on October 28-29, 2016 at the Fresh Water Institute and the Department of Entomology. Next year we will host a joint meeting with the Entomological Society of Canada, 22-25 October 2017.

I have a mission for all of you going to ICE. Promote our Joint meeting with the ESC. We have great line up of symposia and speakers. Talk to your colleagues in the bordering US states. Talk to your colleagues from across Canada. Our joint ESC-ESM meeting has the fortune to be sandwiched between two mega meetings. The ESC will not be having a meeting in Canada this year, and in 2018 it will have a joint meeting with the ESA in Vancouver. So tell your Canadian colleagues, come to Winnipeg in 2017 and to be able to sit and meet with their Canadian colleagues. This pitch will be particularly effective on days 3 and 4 of the meeting in Orlando.

Enjoy the last weeks of summer!

Paul Fields
President, Entomological Society of Manitoba

72nd Annual Meeting
Entomological Society of Manitoba
October 28 & 29, 2016

Harnessing the benefits of natural enemies in agroecosystems

Count yourself in, and join us for the 72nd annual meeting of the Entomological Society of Manitoba.

Friday, 28 October, 2016
Freshwater Institute, 501 University Crescent, Winnipeg (across from the Animal Science/Entomology)

Saturday Morning, 29 October, 2016
Room 219; Animal Science/Entomology, University of Manitoba.

Invited Speakers
Dr. Tatyana Rand, USDA, Billings Montana.
Dr. Héctor Cárcamo, AAFC, Lethbridge Alberta.

IN MEMORY
George H. Gerber*
March 19, 1942, St. Walburg, Saskatchewan – January 13, 2016, Winnipeg, Manitoba

By Robert Lamb

George H. Gerber began his entomological career as a summer student at the Saskatoon Research Station, while studying towards his Bachelor of Science in Agriculture at the University of Saskatchewan. Upon graduation in 1964, George enrolled in biology and completed a Ph.D. thesis in 1968 on the reproductive biology of blister beetles. George was hired in 1969 as a scientist at the Canada Agriculture Research Institute in Belleville, Ontario, where he began a long career investigating the biology of insect pests of crops. In September 1972, George was transferred to the Canada Agriculture Research Station in Winnipeg and was Head of the Crop and Stored-Products Pests Section from 1989 to 1991. George worked there until 1996.

George focused his research on the reproductive biology of insects, particularly the morphology, histology and physiology of reproduction in Coleoptera. He completed detailed studies on blister beetles, *Tenebrio molitor* and the sunflower beetle, the latter in collaboration with G.B. Neill, the first of four graduate students George advised while an Adjunct Professor at the University of Manitoba. In recognition of these early contributions, George was awarded the C. Gordon Hewitt Award for 1981 by the Entomological Society of Canada.

George believed that basic research provides the best foundation for effective applied entomology. So, when he transferred to an integrated pest management group in Winnipeg, he used insect reproduction as the starting point for contributing to the management of insect pests of canola. To broaden his expertise, George took a transfer of work to the Institute of Animal Resource Ecology at the University of British Columbia in 1979. In Winnipeg, he began working on red turnip beetle, with investigations of egg survival, and egg and larval development and host plant interactions. George also contributed his knowledge of insect reproduction to bertha armyworm and other Noctuidae, and ended his research career with a series of papers from 1995 to 1998 on *Lygus* in canola.

George also contributed greatly to the Entomological Societies of Manitoba and Canada. In Manitoba, he served as Regional Director for the Entomological Society of Manitoba to the

* An expanded version of this article is also published in the Bulletin of the Entomological Society of Canada (June 2016), and in the Proceedings of the Entomological Society of Manitoba, the latter with citations and bibliography.

Entomological Society of Canada (1974), as editor of the Manitoba Entomologist (1981), as chair of the Scientific Program Committee (1983), and as Treasurer (1987–1989). At the national level, George served as Secretary of the Entomological Society of Canada (1975–1978), as chair of the By-laws, Rules and Regulations Committee for many years, as Director-at-Large (1981–1984), and as President (1994).

George's life took on a new dimension when he and Margaret Elliott were married in 1992. He and Margaret moved into a new house together and George enjoyed establishing another garden. In retirement George moved on from entomology, but maintained his interest in photographing nature. Through his whole adult life, he was an enthusiastic curler. George was a keen supporter of "Aggie-Row Curlers" almost from the time he arrived in Manitoba. His well-known organizational skills were sometimes tested, when he had to combine his enthusiasm for arriving on time at the curling rink on a Friday afternoon, with his focussed attention to detail in his research life.

OTHER MEETING ANNOUNCEMENTS*

XXV International Congress of Entomology
Entomology without Borders
Entomological Society of Canada Annual Meeting 2016 (Co-located)
Annual Meeting of the Entomological Society of America 2016 (Co-located)
Orlando, Florida, 25-30 September 2016
Webpage: http://www.ice2016orlando.org

The 5th International Forum for Surveillance and Control of Mosquitoes and Mosquito-borne Diseases
Nanjing, China, 22-26 May 2017
www.mosquitoforum.net

The Third Hemipteran-Plant Interactions Symposium
Madrid, Spain, 4-8 June 2017
http://www.hpis2017.csic.es/

IOBC-WPRS working group: Integrated Control in Protected Crops, Temperate Climate
Niagara Falls, Canada, 4-8 June 2017
http://iobccanada2017.ca/

Entomological Society of Canada Joint Annual Meeting 2017
Winnipeg, 22-25 October 2017
The meeting will be held in conjunction with the Entomological Society of Manitoba
http://www.esc-sec.ca/annmeet.php

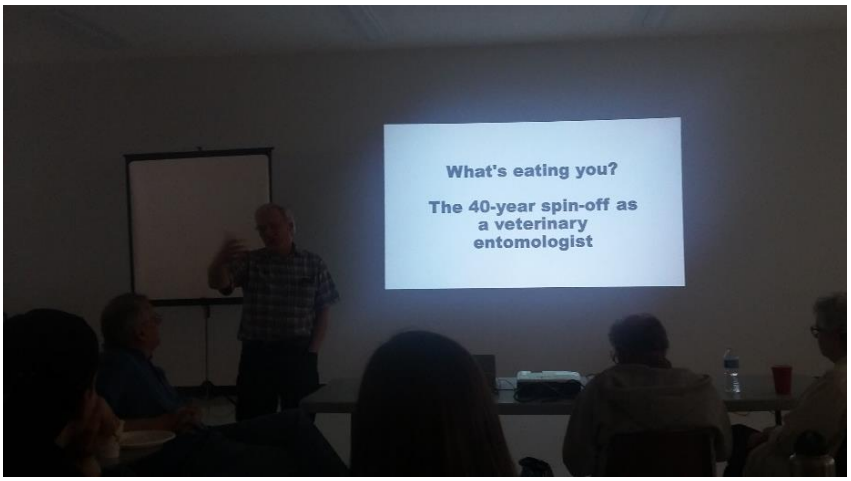
*If you have a meeting you would like listed in the next ESM Newsletter, contact Marjorie Smith or Jordan Bannerman with the details by **30 November 2016**.

ESM New Members Social

By Lisa Capar
Chair, ESM Social Committee

This year's ESM New Members Social luncheon was held on April 27th at the Richmond Kings Community Centre on Silverstone Ave in Winnipeg. We tried a new format this year of ordering pizza followed by a presentation. There was a marvelous turnout of 31 ESM members and friends in attendance. New Members present at the luncheon were: Derek Micholson and Thais Silva. New members unable to attend were: Alison Tayler (Partridge) and Roman Kryuchkov.

After our pizza lunch, Terry Galloway gave a talk entitled “What's eating you? The 40-year spin-off as a veterinary entomologist” based on all his interesting experiences and adventures employed as entomologist at the University of Manitoba; he has recently retired. Terry shared several photographs and stories about small organisms that like to find their way onto or into mammals, including humans! The audience was especially fascinated by the description of burrowing tropical female fleas which can embed themselves into human tissue. Terry enthusiastically went on to discuss other anecdotes about local forensic entomology projects, bed bugs, involvements with the law, and more.



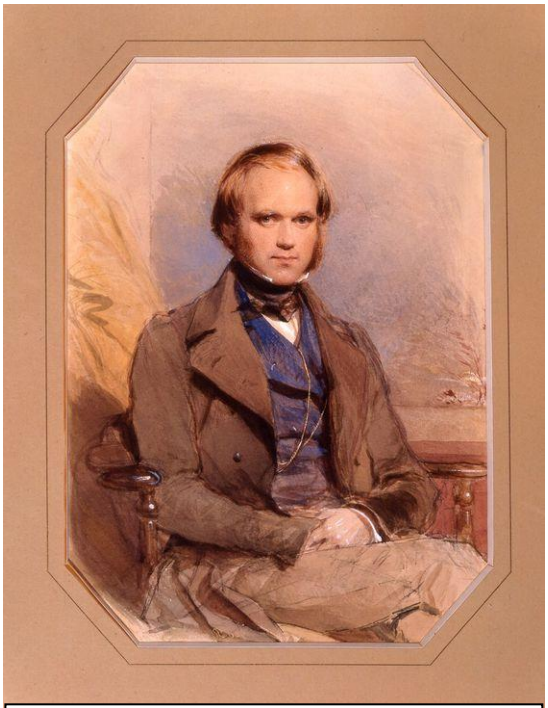
A special thanks to Terry Galloway for volunteering to give a talk and thank you to all those that attended. If anyone has any ideas for future ESM social events, please let me know.

VISITING DARWIN'S INSECTS

By Robert E. Wrigley
Photos are of insects in R.E. Wrigley's own collection

I was searching the internet for images of several species of darkling beetles from Chile, when I happened to come across a photograph of a box of insects collected by Charles Darwin. Suddenly I had a flashback to 1987, when at the University Museum of Zoology, Cambridge, I had the exceptional privilege of being conducted on a tour of the research collections by the Museum Director to observe many of Darwin's specimens, including boxes of insects, vertebrates preserved in liquid, microscopic preparations, and collecting equipment. At that time, I was the Museum Director of the Manitoba Museum, and had accepted a British Council grant to visit my choice of scientific and cultural institutions throughout England, Scotland and Wales. With three weeks of pre-arranged tours (public exhibits and behind-the-scenes collections and laboratories) of a number of grand natural-history museums, art galleries, zoos and botanical gardens, I was able to see famous collections of animal and plant specimens, artifacts, works of art, manuscripts, and maps from some of the classic expeditions of the 19th Century.

Of course, the Darwin collection at Cambridge was at the top of my 'must-see list', and I felt even deeper respect for this remarkable scientist after spending time admiring his original collections, including his favourite group -- beetles -- which he began collecting as a youth and which continued through the years. Insects were preserved on pins in boxes and in liquid preservative, originally as 'Insects in Spirits of Wine." The entire tour of British treasures and the generosity of the British Council Office, and many museum directors and staffs of the institutions, provided a fantastic educational experience, which I will cherish forever. While I did not have time to visit Darwin's Down House, other scientists (e.g., Evans 2009) have offered their impressions on personally standing in the room where Darwin maintained his library and specimens, and on viewing the desk where Darwin prepared his hand-written drafts of his monumental books.



An 1840 painting of Charles Darwin (age 31 years) by George Richmond

Charles Darwin's early interest in insects

Wyhe (2008, p. 14) stated that at Cambridge College; "Darwin became close friends with his cousin William Darwin Fox, who may have introduced Darwin to the latest craze of collecting beetles. Darwin often wrote letters to Fox describing his recent beetle captures. Darwin soon discovered several novel ways of procuring rare and unusual specimens. He had a special cabinet made to house his collections, and sent records of his captures to the well-known

entomologist James Stephens, who published records for all of British entomology at that time. These were Darwin's first words in print, and so, even as an undergraduate, and in a very small way, Darwin had begun to contribute to scientific knowledge."

In Darwin's words (following three paragraphs); "I was very successful in collecting and inventing two new methods; I employed a labourer to scrape in the winter, moss off old trees and place it in a large bag, and likewise to collect the rubbish at the bottom of the barges in which reeds are brought from the fens, and thus I got some very rare beetles. No poet ever felt more delighted at seeing his first poem published than I did at seeing, in Stephen's 'Illustrations of British Insects', the magic words "captured by C. Darwin, Esq." (Smith 1987, p. 7; originally in F. Darwin 1887)

"But no pursuit at Cambridge was followed with nearly so much eagerness or gave me so much pleasure as collecting beetles. It was for the mere passion of collecting; for I did not dissect them, and rarely compared their external characters with published descriptions, but got them named anyhow. I will give proof of my zeal: one day, on tearing off some old bark, I saw two rare beetles, and seized one in each hand; then I saw a third and a new kind, which I could not bear to lose, so that I popped the one which I held in my right hand into my mouth. Alas! it ejected some intensely acrid fluid, which burnt my tongue so that I was forced to spit the beetle out, which was lost, as was the third one." (Smith 1987, p. 7)

"...I have scarcely met anyone who seems to wish to possess my specimens ... I see it quite unreasonable to hope for a minute, that any man will undertake the examination of the whole order. It is clear the collectors so much outnumber the real naturalists, that the latter have no time to spare. I do not even find that the collections care for receiving the unnamed specimens. The Zoological Museum is nearly full & upward of a thousand specimens remain unmounted." (Smith 1987, p. 14)

Smith (1987) also provides a comprehensive list of insects collected by Darwin in England and during the voyage of the Beagle, which were mainly later identified and published upon by various contemporary authorities.

Charles Darwin's "The Voyage of the Beagle"

I admit to a particular fascination about Darwin's adventures and discoveries in southern South America because I was born in Buenos Aires, Argentina, and as a youth (sadly too young to remember much), my family travelled to Chile and Peru (by plane) and Brazil (by plane and ship) -- the same areas visited by Darwin 111 years before my birth, and 184 years ago. Darwin was only 22 when he embarked in 1832 on his 4-year, 9-month voyage -- one of the greatest scientific expeditions of all time.

Darwin collected many of his insects using sweep and aquatic nets, and utilized baits such as dung, carrion, fungi and flowers. He was ably assisted in the field by his servant Syms Covington (Smith 1987). Darwin was well-liked by the Beagle's crew members because he pitched in to help with many of the chores, in spite of his scientific workload and frequent bouts of sea-sickness. They fondly nicknamed him "the fly-catcher" and "the philosopher" (Engel 1962: XIII).

During the voyage of the Beagle, Darwin sent home boxes of insect specimens to Professor John Stevens Henslow (a close friend and professor of botany) for storage at Cambridge. In fact, it was Henslow who had secured Darwin's appointment on the Beagle. Henslow distributed certain taxa to specialists for identification and publication; for example, the coleoptera went to George Robert Waterhouse (Waterhouse 1845), who, incidentally, declined an invitation to join Darwin on the Beagle's voyage. Darwin's entomological specimens were eventually dispersed to the University Museum of Zoology, Cambridge; the British Museum (Natural History), London; Hope Entomological Collections, Oxford University Museum of Natural History; the National Museum of Ireland, Dublin; other museums, and Darwin's Down House. Darwin's original "Insect Notes" are preserved at Down House, while copies of two sets of three note books entitled "Copy of Darwin's notes in reference to insects collected by him" are held in the Entomology Library of the British Museum (Natural History). Cambridge University Library has a short list in Darwin's hand entitled "Insects in Spirits and Wine," which are largely Acari (not insects). (Smith 1987, pp. 20-39)

Darwin occasionally mentions his entomological observations in his Beagle diary and notebooks, but they focus mainly of his daily activities and observations of the local people, geology, plants, and vertebrate animals. However, he noted; "During our stay at Brazil I made a large collection of insects. A few general observations on the comparative importance of the different orders may be interesting to the English entomologist. The large and brilliantly coloured Lepidoptera bespeak the zone they inhabit, far more plainly than any other race of animals." (Darwin 1860, p. 32)

Writing to Henslow from Rio de Janeiro in 1832, Darwin wrote; "I am now collecting fresh-water & land animals: if what was told to me in London is true viz that there are no small insects in the collections from the Tropics. -- I tell entomologists to look out & have their pens ready for describing. -- I have taken as minute (if not more so) as in England, Hydropori, Hygroti, Hydrobii, Pselaphi, Staphylini, Curculio, Bembididous insects etc etc. -- It is exceedingly interesting observing the difference of genera and species from those which I know, it is however much less than I expected... I shall have a large box to send very soon to Cambridge..." (Barlow 1967, p. 55)

In the Introduction to The Voyage of the Beagle by Leonard Engel (1962, pp XX-XXI), the following passage is particularly important, as it relates to an insect and Darwin's future illness.

"In recent years, it has been fashionable to describe Darwin's illness as psychosomatic and to imply that it sprang from a desire to put off his work on evolution ... In 1959, distinguished expert in tropical diseases, S. Adler of Hebrew University, Jerusalem, pointed out that Darwin's symptoms were those of Chagas' Disease, a prolonged debilitating ailment caused by a South American cousin of the parasite responsible for African Sleeping Sickness... And in Luxan, a town in Mendoza, where he stayed overnight, Darwin was subjected to a night-long attack of the 'great black bug of the Pampas' (called the *Reduvius* by Darwin and now know as *Triatoma infestans*), the insect that has been identified as the principal carrier of Chagas' Disease ... his encounter with the 'great black bug of the Pampas' could well have been the cause of his 40 years of invalidism."

The causative agent is now known to be the protozoan *Trypanosoma cruzi*. Smith (1987) also notes that; "... on yet another occasion, this time at Copiapo in Chile, he was exposed to the attacks of the Benchuca. The chances of his contracting Chagas' disease do therefore seem rather high."

In Darwin's (1860, p. 331) own words; "At night I experienced an attack (for it deserves no less a name) of the Benchuca, a species of *Reduvius* ... It is most disgusting to feel the soft wingless insects, about an inch long, crawling over one's body. Before sucking they are quite thin, but afterwards they become round and bloated with blood ... No pain was caused by the wound ... in less than ten minutes it changed from being flat as a wafer to a globular form."

Darwin (1860, p. 30) wrote that; "When we were in Bahia [vic. Rio de Janeiro, Brazil], an elator or beetle (*Pyrophorus luminosus*, Illig.) seemed the most common luminous insect. The light in this case was also rendered more brilliant by irritation. I amused myself one day by observing the springing powers of this insect, which have not, as it appears to me, been properly described."

"I was generally disappointed in the general aspect of the Coleoptera [in Brazil]. The number of minute and obscurely-coloured is exceedingly great. The cabinets of Europe can, as yet, boast only of the larger species from tropical climates. I may mention, as a common instance of one day's (June 23rd) collecting, when I was not attending particularly to the Coleoptera, that I caught sixty-eight species of that order ... Thirty-seven species of Arachnidae, which I brought home, will be sufficient to prove that I was not paying overmuch attention to the generally favoured order of Coleoptera." p. 33

"A person, on first entering a tropical forest, is astonished at the labours of the ants: well-beaten paths branch off in every direction, on which an army of never-failing foragers may be seen ... burdened with pieces of green leaf, often larger than their own bodies. A small dark-coloured ant sometimes migrates in countless numbers." p. 34

"I was very much interested one day by watching a deadly contest between a *Pepsis* [wasp] and a large spider of the genus *Lycosa*. The wasp made a sudden dash at its prey, and then flew away; the spider was evidently wounded ... The wasp soon returned... after much manoeuvring, inflicted two stings on the underside of its thorax. At last, carefully examining with its antennae the now motionless spider, it proceeded to drag away the body." p. 35

"Several times when the ship has been some miles off the mouth of the Plata [river in Argentina]... and off the shores of Patagonia, we have been surrounded by insects. One evening, when we were ten miles from the Bay of San Blas, vast numbers of butterflies ... extended as far as the eye could range. The seamen cried out 'it was snowing butterflies,' ... more species than one were present, but the main part belonged to a kind similar to ... the common English *Colias edusa*. Some moths and hymenoptera accompanied the butterflies; and a fine beetle (*Calosoma*) flew on board. Other instances are known of this beetle having been caught far out to sea; and this is the more remarkable, as the greater number of the Carabidae seldom or never take wing ... When seventeen miles off Cape Corientes, I had a net overboard to catch pelagic animals. Upon

drawing it up, to my surprise I found a considerable number of beetles in it, and although in the open sea, they did not appear much injured by the salt water ... those that I preserved belonged to the genera *Colymbetes*, *Hydroporus*, *Hydrobius*, (two species), *Notaphus*, *Cynucus*, *Adimonia*, and *Scarabaeus* ... it appeared to me most probable that they were floated into the sea by a small stream..." pp. 158-159

"The most remarkable instance I have known of an insect being caught from the land, was that of a large grasshopper (*Acrydium*), which flew on board, when the Beagle was windward of the Cape de Verd Islands, and when the nearest point of land, not directly opposed to the trade-wind, was Cape Blanco on the coast of Africa, 370 miles distant." p. 159

"The zoology of Tierra del Fuego, as might have been expected, is very poor ... Beetles occur in very small numbers ... The few which I found were alpine species (Harpalidae and Heteromidae) living under stones. The vegetable-feeding Chrysomelidae, so eminently characteristic of the Tropics, are here almost entirely absent. I saw very few flies, butterflies, or bees, and no crickets or Orthoptera. In the pools of water I found few aquatic beetles ... Mr. Waterhouse informs me, that of the Harpalidae there are eight or nine species ... of Heteromera, four or five species; of Rhynchophora six or seven; and of the following families one species in each: Staphylinidae, Elateridae, Cebrionidae, Melonthidae." pp. 239-240

"... in Chiloe [Chile] flat land supports the most luxuriant forests ... By sweeping with my insect-net, I procured from these situations a considerable number of minute insects, of the family of Staphylinidae, and others allied to *Pselaphus* and minute Hymenoptera. But the most characteristic family in number, both of individuals and species ... is that of the Telephoridae." p. 287

While along the Peruvian Coast, Darwin noted that; " ... during the few weeks after the rainy season ... the air appears to become quite poisonous; both natives and foreigners often become affected with violent fevers. On the other hand, the Galapagos Archipelago, in the Pacific, with a similar soil, and periodically subjected to the same process of vegetation, is perfectly healthy. Humboldt has observed that under the torrid zone, the smallest marshes are the most dangerous." p. 366

The disease to which Darwin refers here is of course malaria, spread through bites of Anopheline mosquitoes flying from the marshes left by the brief rainy season. The ship's crew was aware that it was safer to sleep offshore on the ship than on the shore, and that islands (without mosquitoes) were often safe from the "miasma."

On the Galapagos Islands, Darwin wrote; "I took great pains in collecting the insects, but, excepting Tierra del Fuego, I never saw in this respect so poor a country. Even in the upper and damp region, I procured very few, excepting some minute Diptera and Hymenoptera, mostly of mundane forms. As before remarked, the insects, for a tropical region, are of very small size and dull colours. Of beetles I collected twenty-five species (excluding a *Dermestes* and *Corynetes* imported, wherever a ship touches); of these two belong to the Harpalidae, two to the Hydrophilidae, nine to three families Heteromera, and the remaining twelve to as many different

families. With the exception of a wood-feeding *Apate*, and of one or probably two water beetles from the American continent, all the species appear to be new." p. 392

In Australia, Darwin notes; "I was interested in finding here the hollow conical pitfall of the ant-lion, or some other insect; first a fly fell down the treacherous slope and immediately disappeared; then came a large but unwary ant; its struggles to escape being very violent, those curious little jets of sand ... flitted by the insect's tail, were promptly directed against the expected victim. But the ant enjoyed a better fate than the fly, and escaped the fatal jaws which lay concealed at the base of the conical hollow." p. 441

On Keeling Island; "Of insects I took pains to collect every kind. Exclusive of spiders, which were numerous, there were thirteen species. Of these only one was a beetle ... a minute elater; Orthoptera, a *Gryllus* and a *Blatta*; Hemiptera, one species; Homoptera, two; Neuroptera, a *Chrysopa*; Hymenoptera, two ants; *Lepidoptera nocturna*, a *Diopaea*, and a *Pterophorus* (?); Diptera, two species ... A small ant swarmed by the thousands under the loose dry blocks of coral, and was the only true insect which was abundant." p. 455

"In Van Diemen's Land [Tasmania], however, I found four species of *Onthophagus*, two of *Aphodius*, and one of a third genus, very abundant under the dung of cows; yet these animals had been then introduced only thirty-three years. Previously to that time, the Kangaroo and some other small animals were the only quadrupeds; and their dung is of very different quality from that of their successors introduced by man. In England, the greater number of stercovorous beetles are confined in their appetites; that is, they do not depend indifferently on any quadruped for the means of subsistence. The change, therefore, in habits, which must have taken place in Van Diemen's Land, is highly remarkable. I am indebted to the Rev. F.W. Hope, who, I hope, will permit me to call him my master in Entomology, for giving me the names of the foregoing insects." p. 488

On the Island of St. Helena; "... goats were introduced in 1502, and in 1724 it is said the old trees had mostly fallen. There can be little doubt that this great change in the vegetation affected not only the land-shells, causing eight species to become extinct, but likewise a multitude of insects ... Among these few insects I was surprised to find a small *Aphodius* (*nov. spec.*) and an *Oryctes*, both extremely numerous under dung. When the island was discovered, it certainly possessed no quadruped, excepting perhaps a mouse. It becomes therefore, a difficult point to ascertain, whether these stercovorous insects have since been imported by accident, or if aborigines, on what food they formerly subsisted. On the banks of the Plata, where, from the vast number of cattle and horses, the fine plains of turf are richly manured, it is vain to seek the many kinds of dung-feeding beetles, which occur so abundantly in Europe. I observed only an *Oryctes* ... and two species of *Phanaeus* ... On the opposite side of the Cordillera in Chiloe, another species of *Phanaeus* is exceedingly abundant, and it buries the dung of cattle in large earthen balls beneath the ground." pp. 487-488

Charles Darwin's "On the Origin of Species by Means of Natural Selection"

I recently acquired a copy of the sixth, 1872 edition (the most complete) of Darwin's classic; "On the Origin of Species by Means of Natural Selection." Darwin's clarity of thought, his phenomenal eye for detail, and the countless examples offered to explain his observations, ideas

and conclusions are overwhelming; one of several reasons why it took him so many years to complete this classic work. His references to insects are distributed liberally throughout the text, illuminating various phenomena of natural history.

Darwin writes; "Mr. B.D. Walsh, a distinguished entomologist from the United States, has described what he calls Phytophagus varieties and Phytophagus species. Most vegetable-eating insects live on one kind of plant or on one group of plants ... In several cases, insects living on different plants have been observed by Mr. Walsh to present in their larval or mature state, or in both states, slight, though constant differences in colour, size, or in the nature of their secretions ... When the differences are rather more strongly marked, and when both sexes and all stages are affected, the forms are ranked by all entomologists as good species." p. 44

"One fly deposits hundreds of eggs, and another, like the hippobosca, a single one. But this difference does not determine how many individuals of the two species can be supported in a district. A large number of eggs is of some importance to those species which depend on a fluctuating amount of food, for it allows them rapidly to increase in number. But the real importance of a large number of eggs or seeds is to make up for much destruction at some period of life; and this period in the great majority of cases is an early one." p. 56

"... in Paraguay, a certain fly lays its eggs in the navels of these animals [cattle and horse] when first born. The increase of these flies, as numerous as they are, must be habitually checked by some means, probably by other parasitic insects. Hence, if certain insectivorous birds were to decrease in Paraguay, the parasitic insects would probably increase; and this would lessen the number of navel-frequenting flies -- then cattle and horses would become feral, and this would certainly greatly alter ... the vegetation: this again would largely affect the insects ... and the insectivorous birds, and so onwards in ever-increasing circles of complexity." p. 60

"The number of humble-bees [old name for bumble bees based on the hum] in any district depends in great measure upon the number of field mice, which destroy their combs and nests; and Colonel Neuman ... believes that 'more than two-thirds of them are destroyed all over England.' Now the number of mice is largely dependent ... on the number of cats ... Hence it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in that district!" pp. 60-61

"In the water beetle, the structure of its legs, so well adapted for diving, allows it to compete with other aquatic insects, to hunt for its own prey, and to escape serving as prey to other animals." p. 63

"Kirby has remarked (and I have observed the same fact) that the anterior tarsi, or feet, of many dung-feeding beetles are often broken off ... In the *Onites apelles* the tarsi are so habitually lost that the insect has been described as not having them. In some other genera they are present, but in a rudimentary condition. In the *Atuechus* or sacred beetle of the Egyptians, they are totally deficient. The evidence that accidental mutilations can be inherited is at present not decisive ... Hence, it will perhaps be safest to look at the entire absence of the anterior tarsi in *Ateuchus* and their rudimentary condition in some other genera, not as cases of inherited mutilations, but due to

the effects of long-continued disuse; for as many dung-feeding beetles are generally found with their tarsi lost, this must happen early in life; therefore the tarsi cannot be of much importance or be much used by these insects.

In some cases we might easily put down to disuse modifications of structure which are wholly, or mainly, due to natural selection ... Mr. Wollaston has discovered the remarkable fact that 200 beetles, out of 550 species ... inhabiting Madeira, are so far deficient in wings that they cannot fly ... For during many successive generations each individual beetle which flew least, either from having its wings been ever so little less perfectly developed or from indolent habit, will have had the best chance of surviving from not being blown out to sea; and, on the other hand, those beetles which most readily took to flight would oftenest have been blown out to sea, and thus destroyed." p. 101

"But Dr. Cruger saw large crowds of humble bees visiting the gigantic flowers of this orchid, not in order to suck nectar, but to gnaw off the ridges within the chamber above the bucket; in doing this they frequently pushed each other into the bucket, and their wings being thus wetted they could not fly away but were compelled to crawl out through the passage formed by the spout or overflow. The passage is narrow, and is roofed over by the column, so that a bee, in forcing its way out, first rubs its back against the viscid stigma and then against the viscid glands of the pollen masses. The pollen masses are thus glued to the back of the bee ... When the bee, thus provided, flies to another flower, or to the same flower a second time, and is pushed by its comrades into the bucket and then crawls out by the passage, the pollen-mass necessarily comes first into contact with the viscid stigma, and adheres to it, and the flower is fertilized." p. 143

[Darwin became so intrigued with the features of pollination of orchids by insects that he published a paper in 1862 entitled; "The Various Contrivances by which British and Foreign Orchids are Fertilized by Insects." Experimenting over a period of 16 years, he published in 1875 a paper on "Insectivorous Plants."]

Leaf-mimic Katydid (Mimetica mortuifolia), Monteverdi, Puntarenas Province, Costa Rica (45 mm).

"Insects often resemble for the sake of protection various objects, such as green or decayed leaves, dead twigs, bits of lichen, flowers, spines, excrement of birds, and living insects ... The resemblance is often wonderfully close, and is not confined to colour, but extends to form, and even to the manner in which the insects hold themselves ... Assuming that an insect originally happened to resemble in some degree a dead twig or a decayed leaf, and that it varied slightly in many ways, then all the variations which rendered the insects at all more like any such object, and thus favoured its escape, would be preserved, whilst other variations would be neglected and ultimately lost." pp. 168-169

"One of the strongest instances of an animal apparently performing an action for the sole good of another ... is that of aphids voluntarily yielding ... their sweet excretion to ants; they do so voluntarily ... Even the quite young aphids behaved in this manner, showing that the action was instinctive, and not the result of experience ... But as the excretion is extremely viscid, it is no doubt a convenience to the aphids to have it removed; therefore probably they do not excrete solely for the good of the ants." p. 188

"Slave-making instinct was first discovered in the *Formica rufescens* ... is absolutely dependent on its slaves; without their aid, the species would certainly become extinct in a single year ... They are incapable of making their own nests, or of feeding their own larvae ... I tried to approach the subject in a skeptical frame of mind, as anyone may well be excused for doubting the existence of so extraordinary an instinct as that of making slaves ... I opened fourteen nests of *F. sanguinea*, and found a few slaves in all ... Hence it is clear that the slaves feel quite at home ... By what steps the instinct of *F. sanguinea* originated I will not pretend to conjecture." pp. 196-198

"Cell-Making Instinct of the Hive Bee. He must be a dull man who can examine the exquisite structure of the comb, so beautifully adapted to its end, without enthusiastic admiration ... Thus, as I believe, the most wonderful of all instincts, that of the hive bee, can be explained by natural selection having taken advantage of numerous, successive, slight modifications of simpler instincts." p. 203

"Locusts are sometimes blown to great distances from the land. I myself caught one 370 miles from the coast of Africa, and have heard of others caught at greater distances ... Now, in parts of Natal it is believed by some farmers, though on insufficient evidence, that injurious seeds are introduced into their grass-land in the dung left by the great flights of locusts which often visit that country. In consequence of this belief Mr. Weale sent me in a letter a small packet of the dried pellets, out of which I extracted under the microscope several seeds, and raised from them seven grass plants, belonging to two species, of two genera. Hence a swarm of locusts, such as that which visited Madeira, might readily be the means of introducing several kinds of plants into an island lying far from the mainland." pp. 282-283

"Sir Charles Lyell informs me that a *Dytiscus* has been caught with an *Ancylus* (a freshwater shell like a limpet) firmly adhering to it; and a water beetle of the same family, a *Colymbetes*, once flew on board the 'Beagle,' when forty-five miles distant from the nearest land; how much farther it might have been blown by a favouring gale no one can tell." p. 296

"We are next led to enquire what reason can be assigned for certain butterflies and moths so often assuming the dress of another and quite distinct form; why, to the perplexity of naturalists, has nature condescended to the tricks of the stage? Mr. Bates has, no doubt, hit on the true explanation. The mocked forms, which always abound in numbers, must habitually escape destruction to a large extent, otherwise they could not exist in such swarms; and a large amount of evidence has now been collected, showing that they are distasteful to birds and other insect-devouring animals. The mocking forms, on the other hand, that inhabit the same district, are comparatively rare, and belong to rare groups ... Messrs. Wallace and Trimen have likewise

described several equally striking cases of imitation in the Lepidoptera of the Malay Archipelago and Africa, and with some other insects." pp. 320-321

"Hence the same names can be given to the homologous bones in widely different animals. We see the same great law in the construction of the mouths of insects; what can be more different than the immensely long spiral proboscis of a sphinx-moth, the curious folded one of a bee or bug, and the great jaws of a beetle? Yet all these organs, serving for such widely different purposes, are formed by infinitely numerous modifications of an upper lip, mandibles, and two pairs of maxillae." p 324

"Most of our best authorities are now convinced that the various larval and pupal stages of insects have thus been acquired through adaptation, and not through inheritance from some ancient form. The curious case of *Sitaris* -- a beetle which passes through certain unusual stages of development, will illustrate how this might occur ... Now if an insect, undergoing such transformations like those of the *Sitaris*, were to become the progenitor of a whole new class of insects, the course of development of the new class would be widely different from that of our existing insects ..." pp. 337-338

"We need not marvel at the sting of a bee, when used against the enemy, causing the bee's own death; at drones being produced in such great numbers for one single act, and then being slaughtered by their sterile sisters ... at the instinctive hatred of the queen bee for her own fertile daughters; at ichneumonidae feeding within the living bodies of caterpillars; and at other such cases. The wonder, indeed, is, on the theory of natural selection, that more cases of the want of absolute perfection have not been detected." p. 352

"It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us ... Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is a grandeur in this view of life ... from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved." p. 362

Charles Darwin's Letters to Alfred Russel Wallace (Marchant 1916)
I am fortunate to own a book by James Marchant entitled; "Alfred Russel Wallace; Letters and Reminiscences," which includes the entire correspondence from 1857-1881 between Wallace and Darwin. The frequent and lively discussions of their natural-history observations and ideas, and the remarkable courtesy expressed in these letters reveal their close friendship and the respect these great scientists had for each other.

Wallace writes: "On a careful consideration, we find a curious series of correspondences, both in mind and in environment, which led Darwin and myself, alone among our contemporaries, to reach identically the same theory. First (and most important, as I believe), in early life both Darwin and myself became ardent beetle-hunters. Now there is certainly no group of organisms that so impresses the collector by the almost infinite number of its specific forms, the endless

modifications of structure, shape, colour, and surface markings that distinguish them from each other, and their numerable adaptations to diverse environments." pp. 93-94

Wallace writes to Darwin: "As to the theory of natural selection itself, I shall always maintain it to be actually yours and yours only. You had worked it out in details I had never thought of, years before I had a ray of light on the subject, and my paper would never have convinced anybody or been noticed as more than an ingenious speculation, whereas your book has revolutionised the study of natural history, and carried away all the best men of the present age. All the merit I claim is the having been the means of inducing *you* to write and publish at once." p. 131

Darwin writes: "On Monday I called on Bates and put a difficulty before him, which he could not answer, and as on some former similar occasion, his first suggestion was, "You had better ask Wallace." My difficulty is, why are caterpillars sometimes so beautifully and artistically coloured? Seeing that many are coloured to escape danger, I can hardly attribute their bright colour in other cases to mere physical conditions. Bates says the most gaudy caterpillar he ever saw in Amazonia (of a Sphinx) was conspicuous at the distance of yards from its black and red colouring whilst feeding on large green leaves. If anyone objected to male butterflies having been made beautiful by sexual selection, and asked why should they not have been made beautiful as well as their caterpillars, what would you answer? I could not answer but should maintain my ground. Will you think over this, and some time, either by letter or when we meet, tell me what you think? Also, I want to know whether your female mimetic butterfly is more beautiful and brighter than the male?" p. 147

Wallace responds by letter that he was preparing a paper on "Mimicry and Protective Colouring," in which he states that the gaudily coloured caterpillars have the similar protection as the adults from attacks by insect-eating birds and other animals by a peculiar odour and taste. p. 147

Darwin; "Bates was quite right. You are the man to apply to in a difficulty. I never heard of anything more ingenious than your suggestion, and I hope you may be able to prove it true. That is a splendid fact about the white moths; it warms one's very blood to see a theory thus almost proved to be true. With respect to the beauty of male butterflies, I must as yet think that it is due to sexual selection; there is some evidence that dragonflies are attracted by bright colours; but what leads me to above belief is so many male Orthoptera and Cicadas having musical instruments. This being the case, the analogy of birds makes me believe in sexual selection with respect to colour in insects. I wish I had strength and time to make some of the experiments suggested by you; but I thought butterflies would not pair in confinement; I am sure I have heard of some such difficulty. Many years ago I had a dragonfly painted with gorgeous colours, but I never had an opportunity of fairly trying it." p. 148.

Darwin; "And now I want to ask you a question. When female butterflies are more brilliant than their males, you believe that they have in most cases, or in all cases, been rendered brilliant so as to mimic some other species and thus escape danger. But can you account for the males not having been rendered equally brilliant and equally protected? Although it may be most for the welfare of the species that the female should be protected, yet it would be some advantage,

certainly no disadvantage, for the unfortunate male to enjoy an equal immunity from danger." p. 175

Darwin; "I am not shaken about the female protected butterflies: I will grant (only for argument) that the life of the male is of very little value; I will grant that the males do not vary; yet why has not the protective beauty of the female been transferred by inheritance to the male? The beauty would be a gain to the male, as far as we can see, as a protection; and I cannot believe that it would be repulsive to the female as she became beautiful; but we shall never convince each other. I sometimes marvel how truth progresses, so difficult it is for one man to convince another unless his mind is vacant." p. 177

Darwin; "You ask me what I think about the gay-coloured females of *Pieris*: I believe I quite follow you in believing that the colours are wholly due to mimicry; and I further believe that the male is not brilliant from not having received through inheritance colour from the female, and from not himself having varied; in short, that he has not been influenced by Selection." p. 178

Darwin; "I write now because I have just received a very remarkable letter from Fritz Muller (with butterfly wings gummed on paper as illustrations) on mimicry, etc." p. 221

Darwin; "With respect to what you say about certain instincts of ants having been acquired by experience or sense, have you kept in mind that the neuters have no progeny? I wish I knew whether the fertile females, or queens, do the same work (viz. placing the eggs in warm places, etc.) as the neuters do afterwards; if so the case would be comparatively simple; but I believe this is not the case, and I am driven to selection of varying pre-existing instincts." p. 229

"My dear Wallace, The beetles have arrived, and cordial thanks: I never saw such wonderful creatures in my life ... I shall wait till my son Frank returns before soaking and examining them ... I am much pleased about the male musk *Callichroma*; [Cerambycidae] for by odd chance I told Frank a week ago that next spring he must collect at Cambridge lots of *Cerambyx moschatus*, for as sure as life he would find the odour sexual!" p. 182-183

"My dear Wallace, I have finished your book [Malay Archipelago]. It seems to me excellent, and at the same time most pleasant to read. That you ever returned alive is wonderful after all your risks and sea voyages, especially that most interesting one to Waigiou and back. Of all the impressions which I have received from your book, the strongest is that your perseverance in the cause of science was heroic. Your descriptions of catching the splendid butterflies have made me quite envious, and at the same time have made me feel almost young again, so vividly have they brought before my mind old days when I collected, though I never made such captures as yours. Certainly collecting is the best sport in the world." p. 194

The Zoology of the Voyage of the H.M.S. Beagle

Darwin's great numbers and taxa of specimens were identified and described by five distinguished authorities in 19 magazine-size numbers which were bound into five volumes (with 166 plates) entitled; "The Zoology of the Voyage of the H.M.S. Beagle." Edited by Charles Darwin, these included tomes on mammals, fossil mammals, birds, reptiles, amphibians and

fishes, but unfortunately none were prepared on insects and marine invertebrates (a government fund ran out, and Darwin became pre-occupied with other projects). (Wyhe 2008, pp. 36-37)

Charles Darwin's "The Descent of Man, and on Selection in Relation to Sex" (Volume 1)
The title of this remarkable two-volume treatise fails to reveal the wide scope of information about the morphology and behaviour of insects and other animals in Volume 1, as Darwin and his colleagues investigated a myriad of natural-history questions of the day. Darwin's powers of observation and interpretation prove extraordinary. Only a brief sample of insect-related notes are offered below.

"The fewness and comparative simplicity of the instincts in the higher animals are remarkable in contrast with those of the lower animals. Cuvier maintained that instinct and intelligence stand in an inverse ratio to each other; and some have thought that the intellectual faculties of the higher animals have been gradually developed from their instincts. But Pouchet, in an interesting essay, has shown that no such inverse ratio really exists. Those insects which possess the most wonderful instincts are certainly the most intelligent ... We can, I think, come to no other conclusion with the respect to the origin of the more complex instincts, when we reflect on the marvelous instincts of sterile worker-ants and bees, which leave no offspring to inherit the effects of experience and of modified habits." pp. 37-38

"Happiness is never better exhibited than by young animals, such as puppies, kittens, lambs, &c., when playing together, like our own children. Even insects play together, as has been described by that excellent observer, P. Huber, who saw ants chasing and pretending to bite each other, like so many puppies." p. 39

"... to describe the habits and mental powers of a female ant, would require ... a large volume; I may however, briefly specify a few points. Ants communicate information to each other, and several unite for the same work, or games of play. They recognize their fellow-ants after months of absence. They build great edifices, keep them clean, close the doors in the evening, and post sentries. They make roads, even tunnel under rivers. They collect food for the community, and when an object, too large for entrance, is brought to the nest, they enlarge the door, and afterwards build it up again. They go out to battle in regular bands and freely sacrifice their lives for the common weal. They emigrate in accordance with a preconcerted plan. They capture slaves. They keep aphids as milch-cows. They move the eggs of their aphids, as well as their own eggs and cocoons, into warmer parts of the nest, in order that they may be quickly hatched; and endless similar facts could be given." pp. 186-187

"Throughout the great class of insects the males almost always emerge from the pupal state before the other sex, so that they generally swarm for a time before any females can be seen. The cause of this difference between the males and the females is sufficiently obvious. Those males which annually first migrated into any country, or which in spring were first ready to breed, or were the most eager, would leave the largest number of offspring; and these would tend to inherit similar instincts and constitutions ... there is a constantly recurrent struggle between the males for the possession of the females." p. 260

"On the whole, from the above various sources of evidence, all pointing to the same direction, I infer that with most species of Lepidoptera, the males in the imago state generally exceed the females in number, whatever the proportions may be at their first emergence from the egg. With reference to the other Orders of insects, I have been able to collect very little reliable information. With the stag-beetle (*Lucanus cervus*) the males appear to be much more numerous than the females ..." p. 313

"In the immense class of insects, the sexes sometimes differ in their organs for locomotion, and often in their sense organs, as in the pectinated and beautifully plumose antennae of the males of many species ... "It is astonishing," as Mr. B.D. Walsh has remarked, "how many different organs are worked in by nature, for the seemingly insignificant object of enabling the male to grasp the female firmly"... The tarsi of the front-legs are dilated in many male beetles, or are fashioned with broad cushions of hairs; and in many genera of water-beetles they are armed with a round flat sucker, so that the male may adhere to the slippery body of the female." pp. 341-343

"The purpose of the luminosity in the female glowworm is likewise not understood; for it is very doubtful whether the primary use of the light is to guide the male to the female ... Fritz Muller informs me that the most luminous insect which he ever beheld in Brazil, was the larva of some beetle. Both sexes of certain luminous species of *Elater* emit light. Kirby and Spence suspect that the phosphorescence serves to frighten and drive away enemies." p. 345

"With insects of all kinds the males are commonly smaller than the females, and this difference can often be detected even in the larval state ... There are, however, exceptions to the rule of male insects being smaller than the females; and some of these exceptions are intelligible. Size and strength would be an advantage to the males, which fight for the possession of the female; and in these cases the males, as with the stag-beetle (*Lucanus*), are larger than the females. There are, however, other beetles which are not known to fight together, of which the males exceed the females in size; and the meaning of this fact is not known; but in some of these cases, as with the huge *Dynastes* and *Megasoma* [Scarabaeidae], we can at least see that there would be no necessity for the males to be smaller than the females, in order to be matured before them, for these beetles are not short-lived, and there would be ample time for the pairing of the sexes." pp. 345-347

Hercules Beetle (Dynastes hercules), Sao Paulo de Olivenca, Amazonas State, Brazil (126 mm)

Megasoma acteon, Amazon River, Para State, Brazil (110 mm)

"Many observers believe that when gnats (Culicidae) dance in the air in a body, alternately rising and falling, the males are courting the females ... The mental faculties of the Diptera are probably fairly well developed, for their nervous system is more highly developed than in most other Orders of insects." p. 349

"Everyone who has wandered in a tropical forest must have been astonished at the din made by the male Cicadae. The females are mute; as the Grecian poet Xenarchus says, "Happy the Cicadas live, since they all have voiceless wives." The noise thus made could be plainly heard on board the "Beagle," when anchored at a quarter of a mile from the shore of Brazil." p. 350

"The males in the three saltatorial families belonging to this order [Orthoptera] are remarkable for their musical powers, namely the Achetidae or crickets, the Locustidae ... and the Acrididae or grasshoppers. The stridulation produced by some of the Locustidae is so loud that it can be heard during the night at a distance of a mile, and that made by certain species is not unmusical even to the human ear, so that the Indians on the Amazons keep them in wicker cages. All observers agree that the sounds serve to either call or excite the females." p. 352

"Many beetles are coloured so as to resemble the surfaces which they habitually frequent. Other species are ornamented with gorgeous metallic tints, -- for instance, many Carabidae which live on the ground and have the power of defending themselves by an intensely acrid secretion ... These splendid colours [of Chrysomelidae], which are often arranged in stripes, spots, crosses and other elegant patterns, can hardly be beneficial, as a protection ... Hence the suspicion arises, that they serve as a sexual attraction; but we have no evidence on this head, for the sexes rarely differ in colour." pp. 366-367

"A most remarkable distinction between the sexes of many beetles is presented by the great horns which arise from the head, thorax, or clypeus of the males; and in some few cases from the under surface of the body. These horns, in the great family lamellicorns, resemble those of various quadrupeds, such as stags, rhinoceroses, &c., and are wonderful both from their size and diversified shapes ... The females generally exhibit rudiments of the horns in the form of small knobs or ridges; but some are destitute of even a rudiment." p. 370

"The conclusion, which best agrees with the fact of the horns having been so immensely yet not fixedly developed [in Scarabaeidae], -- as shown by their extreme variability in the same species and by their extreme diversity in closely-allied species -- is that they have been acquired as ornaments. pp. 371-372

"The male *Chiasognathus grantii* of S. Chile -- a splendid beetle belonging to the same family [Lucanidae] -- has enormously-developed mandibles (fig. 23); he is bold and pugnacious; when

Stag Beetle (Chiasognathus grantii), Malleco Province, Chile (65 mm)

threatened on any side he faces round, opening his great jaws, and at the same time stridulating loudly; but the mandibles were not strong enough to pinch my finger so as to cause pain. Sexual selection, which implies the possession of considerable perceptive powers and strong passions, seems to have been more effective with the Lamellicorns than with any other family of the Coleoptera or beetles."
p. 377

"Lastly the male *Ateuchus* [a dung beetle] stridulates to encourage a female in her work, and from distress when she is removed. Some naturalists believe that beetles make this noise to frighten away their enemies; but I cannot think that the quadrupeds and birds which are able to devour the larger beetles with their extremely hard coats, would be frightened by so slight a grating sound. The belief that the stridulation serves as a sexual call is supported by the fact that death-ticks (*Anobium tesselatum*) are well known to answer each other's ticking ..." p. 384

"Finally it seems probable that the two sexes of many kinds of beetles were at first enabled to find each other by the slight shuffling noise produced by the rubbing together of the adjoining parts of their hard bodies; and that as the males or females which made the greatest noise succeeded best in finding partners, the rugosities on various parts of their bodies were gradually developed by means of sexual selection into true stridulating organs." p. 387

" As so many gorgeous butterflies inhabit the tropics, it has often been supposed that they owe their colours to the great heat and moisture of these zones; but Mr. Bates has shown by the comparison of various closely-allied groups of insects from the temperate and tropical regions, that this view cannot be maintained; and the evidence becomes conclusive when brilliantly-coloured males and plain-coloured females of the same species inhabit the same district, feed on the same food, and follow exactly the same habits of life. Even when the sexes resemble each other, we can hardly believe that their brilliant and beautifully-arranged colours are the purposeless result of the nature of tissues, and the action of the surrounding conditions." p. 391

"Inheritance is governed by so many unknown laws or conditions, that they seem to us to be most capricious in their action." pp. 409-410

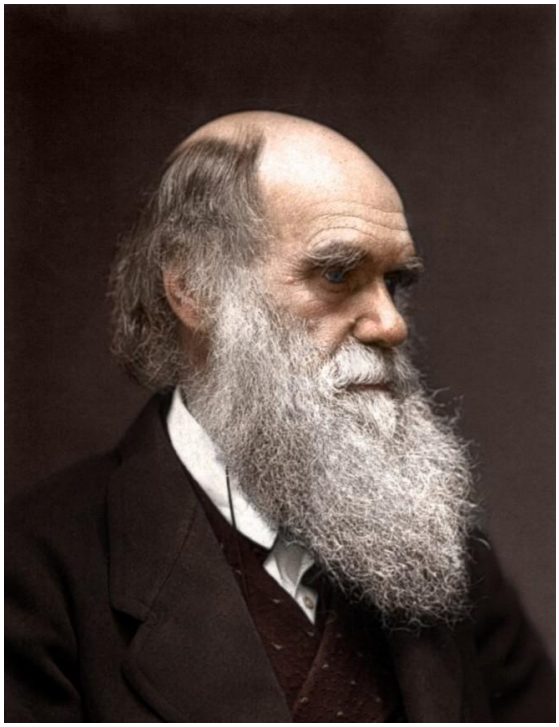
"It had previously been observed that certain butterflies in S. America belonging to quite distinct families, resembled the Heliconidae so closely in every stripe and shade of colour that they could not be distinguished except by an experienced entomologist ... Mr. Bates inferred that the butterflies which imitate the protected species had acquired their present marvelously deceptive appearance, through variation and natural selection, in order to be mistaken for the protected kinds and thus to escape being devoured." p. 411

"From the small size of insects, we are apt to undervalue their appearance. If we could imagine a male *Chalcosoma* [Scarabaeidae] (fig. 15), with its polished, bronze coat of mail, and its vast complex horns, magnified to the size of a horse or even of a dog, it would be one of the most imposing animals in the world." p. 419

Atlas Beetle (Chalcosoma caucasus), East Java, Indonesia

"Sexual selection implies that the more attractive individuals are preferred by the opposite sex; and as with insects, when the sexes differ, it is the male which, with rare exceptions, is the most ornamented ... and as it is the male which searches eagerly for the female, we must suppose that the females habitually or occasionally prefer the more beautiful males, and that these have thus acquired their beauty ... the females have the power of rejecting any particular male, we may safely infer from the many singular contrivances possessed by the male, such as great jaws, adhesive cushions, spines, elongated legs, &c., for seizing the female; for these contrivances shew that there is some difficulty in the act." p. 421

Other Resources on Charles Darwin



Continuing my internet search for further information about Darwin and his entomological contributions, I found a great article on Darwin's insects which I recommend highly. The full notation is: "Darwin's Insects -- Charles Darwin's Entomological Notes," by Kenneth G.V. Smith (Editor), 24 September 1987. Bulletin of the British Museum (Natural History), Vol. 14(1): 1-141. Additional information is located in; "The Complete Work of Charles Darwin Online," John van Wyhe, editor, 2002-. (http://darwin-online.org.uk/).

The recent (2008) book by John van Wyhe offers an attractively presented and concise account of Darwin's life and work, supplemented with dozens of photographs of contemporary persons and illustrations of wildlife art, and pull-out copies of original maps, letters, lists, and sections of diaries; an essential book for Darwin enthusiasts. These and several other on-line resources on Darwin are listed in the following References. I hope this article will spark further interest in others to explore these rich sources about Charles Darwin and his great age of discovery.

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