



Naturalist in Review #58 SLEEPING SICKNESS AND MIMICRY

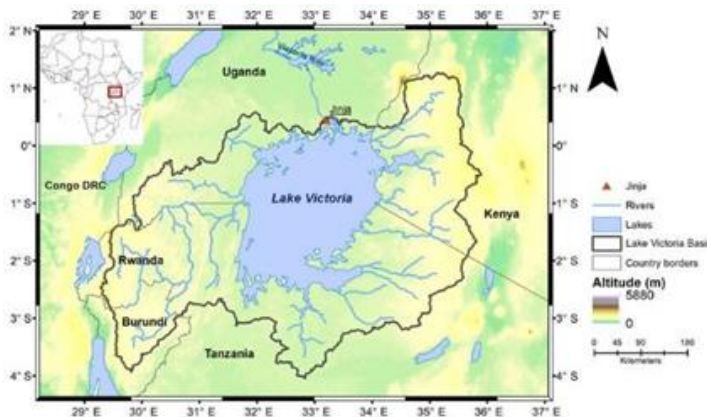
By Christopher K. Starr

Review of:

G.D. Hale Carpenter 1920. *A Naturalist on Lake Victoria*. New York: E.P. Dutton 333 pp. (Available online at the Biodiversity Heritage Library and the Internet Archive)

[58th in a series on "naturalist-in" books; see www.ckstarr.net/reviews_of_naturalist.htm]

The previous review introduced the African Great Lakes and dealt with an account set in one of them, Lake Malawi. Here I turn to Lake Victoria, the largest in surface area at almost 69,000 km².



Hydrology and Earth System Sciences

Geoffrey Douglas Hale Carpenter (1882-1953) studied tropical medicine in London. He went to East Africa to study the natural history of the sleeping sickness that had long seriously debilitated many parts of Africa. The disease (trypanosomiasis) is caused by flagellated protozoans in the blood, which are transmitted through bites from tsetse flies (*Glossina* spp.). In the area where Carpenter worked, this was no trivial matter. The disease was usually fatal within two or three years, and an epidemic begun in 1901 had wiped out entire villages. In 1906 the survivors were relocated to disease-free areas.

The book is an account of his life from early 1911 until the start of First World War in August 1914, with a short return visit to the area soon

after the war. During the war he was stationed in his medical capacity in various parts of East Africa. He found that at most of his postings he had little to do, and at one the hospital that he directed received no patients at all. His wartime duty left plenty of time for natural history, and his follow-up book *A Naturalist in East Africa* is replete with observations, mainly of insects. In the book treated here, he resided on islands in the northwest part of the lake. Carpenter established a daily routine that was only interrupted occasionally by rough weather. He was up a little before dawn, had a swim and then breakfast, after which he went to a field site by walking and/or canoeing. He spent some hours collecting samples, which he then took back to the base for microscopic examination—except on Sundays, which were devoted to butterfly collecting and other extracurricular occupations.

The book has 13 chapters, mostly about insects, but with three chapters on vertebrates. An extensive index shows its overall seriousness. There are plenty of indifferent photographs, mostly habitat shots, supplemented by graphs and tables.

The first chapters are about sleeping sickness. The *Trypanosoma* agents and vectors were already known at the time, but there was much to be learned about the symptoms and progress of the disease. In addition, he collected data on the ecology and life history of the main tsetse flies and estimated their abundance by standard sampling methods with local assistants. The flies were found also to feed various other mammals, as well as crocodiles and other reptiles. He looked for their breeding sites and tried to identify important natural enemies of the flies. None of these appeared to have any large impact. Without explicitly emphasizing it, Carpenter's book illustrates the key importance of basic biological understanding in epidemiology.

It was apparent that the sleeping sickness could be stopped if they could keep two kinds of animals apart from each other: the tsetse flies and



How stuff works

the situtunga antelope (*Tragelacphus spekei*). It is mainly from this antelope that the flies obtain the trypanosome. The antelope is typically found in swampy areas and is presumed to swim readily among the islands and the mainland. Carpenter coolly considered whether the solution might be simply to exterminate the antelope and concluded that this was impractical. If the aim is to wipe out the flies, on the other hand, one must look for the most vulnerable life-stage. One could cut down all the bushes under which the fly deposits its larvae just before they pupate, but that would still be an enormous task. As an alternative, he thought it might work to set out a great many very attractive larviposition sites, from which the masses of pupae could be destroyed.



Vecteezy

Carpenter used long canoes with several paddlers and a steersman to get around. Even with such a crew, a canoe is not easy to manage if it is windy or the water rough. With this background, he described a tour of inspection of the islands in two big canoes with a combined crew of 54. He gives notes on each of the islands and the animals encountered on them. They were there of course

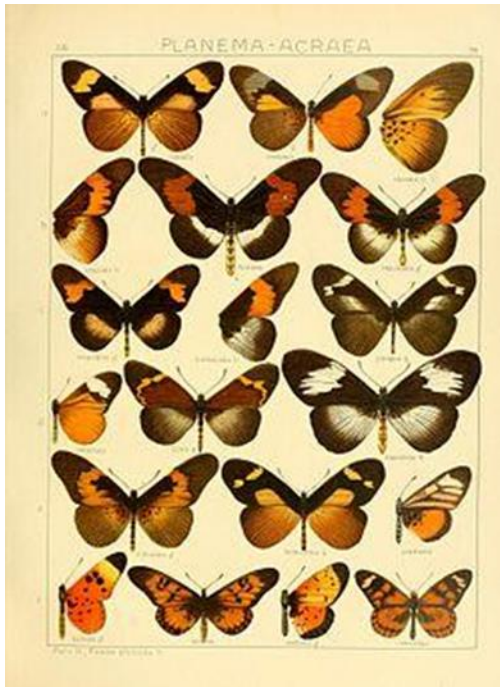
to survey the tsetse flies, but the opportunity was not lost to collect and study other insects. There is a table of numbers of each family noted on each of 21 islands.

At a time when the theory of evolution's heroic period was still in living memory, Carpenter's several in-depth topics are all in the light of natural selection. This is most evident in a chapter on "The Colouration of Insects" and the chapter following it. Poulton (1890) had classified animal colouration according to adaptive value, including crypsis, mimicry and warning colouration. Many of Carpenter's observations of Lake Victoria insects in this regard are rather casual, but it should be noted that the mass of observations from Africa at that time was less than in the New World and Asian tropics. He gave special attention to various grasshoppers, which could be distasteful or not, warningly coloured or not. He tried out various of these and various caterpillars on tame monkeys and chickens.

A striking feature of tropical wildlife, both on land and in the sea, is the number of close resemblances among animals that are no more than distantly related to each other. These provide examples of convergent evolution, but why have they come about? In an early major success for the theory of evolution by natural selection, Henry Walter Bates (see review no. 30) explained this phenomenon on the basis of butterflies in the Amazon. He reasoned that where one species in a pair was markedly distasteful (the model), another, edible species (the mimic) gained a protective advantage from predation through an evolved resemblance to the model.

Following on Bates and other earlier researchers (especially Punnett 1915), Carpenter applied this perspective to the butterflies that he saw around him in East Africa.

His main focus was members of the genus *Bematistes*, known as wanderers, and their mimics in the genus *Pseudacraea*, known as false wanderers. *B. macarista*, in particular, is sexually dimorphic, and both sexes appear to be mimicked by the corresponding sexes of *P. eurytus*. The book includes a table of various forms of *P. eurytus* and eight apparent *Pseudacraea* mimics. However, it was not enough to show the parallel resemblances and the fact that one species is markedly less tasty



Left: Forms of a polymorphic *Bematistes*; Wikipedia, Right: A mimetic *Pseudacraea*.
Note that both genus names have been changed.

(at least to a human) than the other. As Carpenter noted, a scarcity of any direct evidence of selective agents poses a persistent difficulty in the theory of mimicry. However, he was able to compile convincing indirect evidence in the form of abundant beak marks from birds on butterfly wings.

And if mimicry is shaped by natural selection, were the changes in the mimics' appearance sudden or gradual? Carpenter's experiments showed that even a small change toward resembling an unpalatable species could have survival value, consistent with the gradualist view.

Carpenter has some interesting observations on various solitary wasps, but these are mostly not identified to species. His observations of other land invertebrates leave the impression that they were jotted down in passing with little attention. After butterflies, Carpenter's second extracurricular interest was birds. In a long chapter about them, he dwelt especially on water and shore birds, with notes on a great many species and a focus on large faunistic differences between the islands and the mainland shore zone. His sense of ecology shows up in the (unanswered) question of why there were no flamingoes in Lake

Victoria, which would seem to have everything for them. And his sense of data is in evidence in a table of stomach contents from 48 bee-eaters of two species.



Bee Eaters (Photo - San Diego Zoo)

Two shorter chapters on other vertebrates are largely wasted, amounting mostly to casual notes that tell us nothing in particular. Most notably, there is no mention of cichlid fishes, which are hugely speciose in Lake Victoria. The one part that shows Carpenter's originality treats the relationship between the Nile crocodile and the monitor lizard *Varanus niloticus*. Crocodiles were conspicuously scarce and difficult to approach in

that part of Lake Victoria. Still, he was able to excavate 13 of their nests, each with between 38 and 76 eggs.



Nile crocodile; Victoria Falls Travel Guide.

The monitor lizard was the most notable reptile on the islands. Like some others in its genus, it is amphibious and takes readily to the water when disturbed. In comparisons among the islands, Carpenter found an inverted ratio of the two big reptiles, so that one is more abundant where the other is rarer. The most likely reason is that crocodile eggs form a large part of the lizard's diet. And because the lizard is eagerly hunted by the local people, it had become much more abundant (and crocodiles correspondingly scarce) on the islands since the people had been transferred.

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