

# The Coconut Palm, The Robber Crab and Charles Darwin: April Fool or a Curious Case of Instinct?\*

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When Charles Darwin wrote his *Journal of Researches into the Natural History and Geology of the Countries visited during the voyage of H.M.S. Beagle round the World, under the Command of Capt. Fitz Roy, R.N.* it appeared that the date, Friday, 1st April, 1836, held no special presentiment for him. His entry for that day reads, "*April 1st.*—We arrived in view of the Keeling or Cocos Islands, situated in the Indian Ocean, and about six hundred miles distant from the coast of Sumatra. This is one of the lagoon-islands (or atolls) of coral formation, similar to those in the Low Archipelago which we passed near. When the ship was in the channel at the entrance, Mr. Liesk, an English resident, came off in his boat" (Darwin 1845, p. 452). At that time, Mr. Liesk might have been lonely because, according to the Darwin scholar, R. B. Freeman (personal communication 1981), the only other English speaking resident, Captain John Clunies Ross, had gone away to Singapore. So that, if Mr. Liesk knew it was April Fool's Day, then the unexpected arrival of a vessel flying the Union Jack was too good an opportunity to miss. If he was tempted to play a practical joke, then of all the people on board the Beagle, who would be a better April Fool target than the eager young naturalist whose very inquisitiveness might seem like gullibility?

It is unlikely that Mr. Liesk played a

"practical" joke, in the physical sense, because Darwin says (p. 453) that he did not go ashore until the next morning, after anchoring. The joke had to be a verbal one and, if it was successfully perpetrated, then Darwin included it, unknowingly, in his Journal narrative for April 1st. He began his account of the islands with a history of the inhabitants, "in as few words as possible," made a comment on slavery which would have been a topical subject at the time of publication, and gave a resume of the islands' economy, "... the main vegetable production is the coconut. The whole prosperity of the place depends on this tree: the only exports being oil from the nut, and the nuts themselves, which are taken to Singapore and Mauritius, where they are chiefly used, when grated, in making curries. On the coconut, also, the pigs, which are loaded with fat, almost entirely subsist, as do the ducks and poultry. Even a huge land-crab is furnished by nature with the means to open and feed on this most useful production" (p. 453).

## The Crab and the Coconut

The remarkable behavior of the coconut crab, or robber crab, *Birgus latro* L., was the subject of travellers' tales long before Darwin's day. It was mentioned by Rumphius (1741) and by Soleyman in the tenth century (Reyne 1939, quoted by Davis and Altevogt 1978). The crab is supposed to climb up the trunk of the coconut palm, into the crown of leaves, and cut off the fruit. It then climbs down

\* For other pictures and more about Robber Crabs see *Principes* 27: 89-93.

again, to peel the fallen fruit, accumulating fibers from the thick husk as a bed in its burrow. Last, but by no means least, it cracks the hard nut and digs out, and eats, the oily endosperm.

Like any good raconteur, Mr. Liesk would not have insisted on the absolute authenticity of every part of his story, because he would know that to do so would strain his victim's credulity. So he disclaimed the crab's ability to climb and Darwin duly reported, "It would at first be thought quite impossible for a crab to open a strong cocoa-nut covered with the husk; but Mr. Liesk assures me that he has repeatedly seen this effected. The crab begins by tearing the husk, fibre by fibre, and always from that end under which the three eye-holes are situated; when this is completed, the crab commences hammering with its heavy claws on one of the eye-holes till an opening is made. Then turning round its body, by the aid of its posterior and narrow pair of pinchers, it extracts the white albuminous substance . . . . These crabs inhabit deep burrows, which they hollow out beneath the roots of trees; and where they accumulate surprising quantities of the picked fibres of the cocoa-nut husk, on which they rest as on a bed . . . . It has been stated by some authors that the Birgos crawls up the cocoa-nut trees for the purpose of stealing the nuts: I very much doubt the possibility of this; but with the *Pandanus* the task would be very much easier. I was told by Mr. Liesk that on these islands the Birgos lives only on the nuts which have fallen to the ground" (pp. 462-463).

Although there is no reason think that Darwin suspected a practical joke, he would naturally be sceptical until he had seen the crab for himself. The first opportunity to do so may have been on Sunday, 3rd April, when he reported (p. 458) that he and Captain Fitz Roy were entertained to dinner at the settlement. This occasion would have given Mr. Liesk a chance to embroider his original story. For instance,

he may have known the reputed method for catching the crab. This is to climb up after it and, when it has entered the crown of the palm, tie a rope made of grass around the trunk just below the leaf canopy. When the crab descends, *tail first*, it feels the grass and, supposing itself to be on the ground, lets go and falls to its death on stones carefully placed below (Green 1961, quoted by Davis and Altevogt 1978). Mr. Liesk would also have served coconut crab as part of the meal and this would allow Darwin to mention that the crab "grows to a monstrous size" and "is very good to eat" (pp. 462-463). His other statements clearly depended on Mr. Liesk's information rather than on his own observations. On his return to England, Darwin added a footnote supporting his view that the crab might climb *Pandanus* (Zoological Society of London, 1832) and a paragraph about the places it had been found, "Captain Moresby informed me that this crab inhabits the Chagos and Seychelle groups, but not the neighbouring Maldiva Archipelago. It formerly abounded at Mauritius, but only a few small ones are now found there. In the Pacific, this species, or one with closely allied habits, is said to inhabit a single coral island, north of the Society group" (p. 463). Also according to Captain Moresby, one crab even escaped from a wired-down, tin biscuit-box, illustrating for Darwin, "the wonderful strength of the front pair of pincers" (p. 463).

It is on the basis of Darwin's *subsequent* reputation, that this version of the coconut crab's habits has colored many popular natural histories. Reference books, such as the *Encyclopedia Britannica*, still mention it and it is discussed by scientists—from agriculturalists and botanists to geographers and zoologists. Circumstantial evidence that the crab can climb has, apparently, been validated by movie films which show it going head first in either direction, up or down (Davis and Altevogt 1978). No such proof has been

obtained to confirm that it can peel or crack a coconut, though it is generally agreed that it will eat coconut endosperm from an already broken nut. It is, in fact, polyphagous and will even eat dead coconut crabs (Rock 1916).

The association between the crab and the coconut has also been the basis for speculation about the original home of the coconut—a question which botanists have failed satisfactorily to resolve (Beccari 1917, Child 1974, Harries 1978). Thus, Beccari, arguing against an American origin for the coconut, because the coconut crab is not found on that continent, added his own variation to Darwin's theme. He suggested that the thick husk of the coconuts growing on Palmyra Island in mid-Pacific was an evolutionary adaptation—hypertrophy of the pericarp, stimulated by the efforts of the crab to reach the seed of the young fruit. Beccari's other arguments were more convincing.

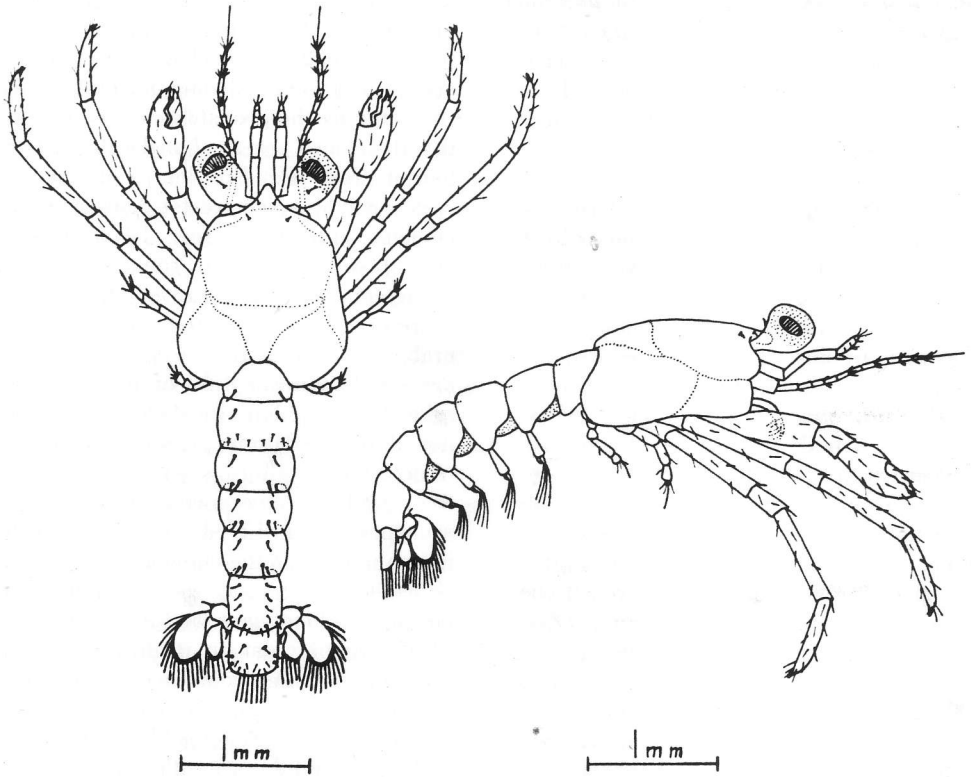
Current opinion, which favors a Melanesian origin for the coconut, admits that while the evidential value of the association confirms conclusions drawn from botanical, historical or ethnological considerations it fails to pinpoint a precise location because the crab is found over such a wide extent of the tropics, in the Indian and Pacific Oceans from 40°E to 140°W (Child 1974). Those who do not entirely rule out an American option suggest that the relationship between the crab and the coconut is almost incidental (Purseglove 1972). This, in effect, is a polite way of saying that Darwin was wrong. But, if Darwin's account was not factual, *then for that very reason* a far more satisfactory explanation can be offered. Of course, any mundane ideas about the crab and the coconut will not have the romantic appeal of Darwin's fascinating version.

### A New Hypothesis

The coconut crab is remarkable chiefly for being a land-living hermit crab that

does not carry a shell to protect its abdomen. The final size of the crab, which may weigh up to 2½ kg and measure 15 cm across (or 45 cm including pincers), is not restricted by the availability or the size of the abandoned sea snail shells that other hermit crabs use. Freedom from such a shell would also give greater mobility when climbing, although Warner (1977) considers robber crabs to be "rank amateurs" when compared to *Grapsus*, the rocky shore crab, or *Aratus*, the mangrove tree crab. By any criteria, the only evolutionary situation in which the crab could fore-sake the protection of a shell is when it is not at risk from any predator and when circumstances afford a superior alternative. Such an environment is found on archeipelagic coral atolls, where the coconut palm became the dominant plant form (Harries 1978), and the coconut crab became the dominant land animal (Reese 1965). Its only danger might come from sea birds and this could account for differences of opinion as to whether it is diurnal or nocturnal. Whereas Darwin, Rock, and Davis and Altevoigt all say it is diurnal, Daniel and Prem Kumar (1947, quoted by Davis and Altevoigt 1978) say it is mostly nocturnal in Great Nicobar Island (and Helfman (1977) considered it nocturnal in the Marshall Islands). By day fully grown adult crabs may be safe from aerial attack; smaller young crabs may not and would come out only at night.

The ability of the coconut to reach other parts of the same atoll or other atolls, or to colonize newly emerged volcanic islands, or to occasionally establish on suitable continental mainland beaches, is the result of natural dissemination by floating (Harries 1978). That is the process which greatly contributed to the evolution of the thick husk noted by Beccari and observed in similar habitats in both the Pacific and Indian Oceans (Sauer 1967). The true association is, therefore, between the crab and the husk of the coconut, but not as Beccari surmised. Instead, it is proposed

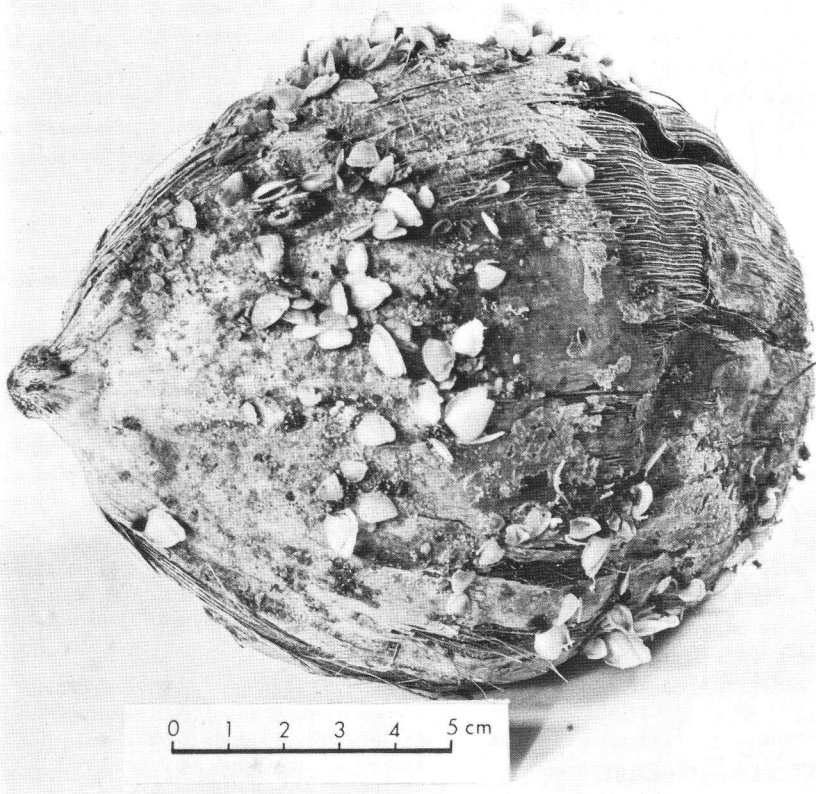


1. Glaucothoe stage of *Birgus latro*; dorsal and lateral views. From Reese and Kinzie (1968).

that the postlarval glaucothoe stage of the crab (Fig. 1, note small size of this stage) chooses to live in cracks and crevices of the coconut husk while it is floating—as other hermit crabs have chosen, not shells, but holes in corals and sponges (Burton and Burton 1976). The moist, but aerated, environment in the softer fibers at the eye end of a floating coconut would also be shared by other marine organisms, some of which would be the coconut crab's prey. For example, Ward and Allen (1980) tested the viability of floating coconuts and recorded that, "While afloat the nuts were colonized by crabs, barnacles, and seaweed (See Fig. 2). The effects of these 'passengers' on germination is not known but the nut which germinated after

immersion for 74 days was carrying barnacles and seaweed, and small crabs had taken up residence in the top of the nut where the husk was beginning to come away from the endocarp." The crab could, of course, cling to other flotsam, trunks and leaves, but these would tend to enter the water in small numbers and fairly infrequently after windstorms and tsunamis. By contrast, the monthly flowering of the coconut palm throughout the year ensures a constant dropping of fruits, many of which fall into the lagoon (Rock 1916) or into the open sea.

The coconut, as a surrogate home, would not only replace the mollusc shell, it would also provide the means whereby the crab can become widely dispersed. The



2. Barnacle encrusted coconut showing crevices in the husk that would shelter young crabs and protect them from dehydration. Photo by R. Gerard Ward.

pre-glaucothoe stage, lasting 20–30 days (Reese and Kinzie 1968), cannot hope to achieve the range of floating coconuts which can stay in the water at least 214 days (Ward and Allen 1980), and probably longer. When washed up on a beach the coconut might begin to germinate but the combined floating and germination period can exceed 220 days (Harries 1981) and until the husk becomes completely permeated by roots, the young crab would be protected from dehydration. If the coconut does not germinate, perhaps because the crab itself has damaged the growing point, then the rotting endosperm, oozing out of the soft eye which is almost always the primary focus for

decomposition, would nourish the crab and provide bait for its prey. In that situation the crab might stay with the coconut indefinitely so that, eventually, all that remains is sand covering over the fibers of husk and fragments of shell. This would easily give the appearance of a burrow, a purposefully accumulated bed of fibers and a nut that had been intentionally peeled and cracked.

As soon as primitive man began to take an interest in the crab and the coconut, as food and drink, then the association between the two became less obvious. Man planted coconuts inland, where they did not naturally grow, and took them to islands which they could not reach by

floating. On small islands he might eat the crab into extinction. In each case, coconuts would eventually seem to grow where there were no crabs. Conversely, the crab is a successful life-form and can opportunely use floating logs for dispersal and mollusc shells for temporary protection (Reese 1968). It would, therefore, survive in the absence of the coconut palm. Unfortunately, man's early interest in the coconut crab stopped at its culinary qualities and his later curiosity was satisfied by the just believable—or almost unbelievable—feats attributed to it.

The new hypothesis can be tested by observation and experiment but, even if it turns out to be substantially correct, it will never entirely replace Darwin's intriguing account. Nor will it affect his conclusions—"I think this is as curious a case of instinct as ever I heard of, and likewise of adaptation in structure between two objects apparently so remote from each other in the scheme of nature, as a crab and a cocoa-nut tree" (p. 463).

### Who Laughs Last

Three questions remain. Did Mr. Liesk really try to April Fool Charles Darwin? Did Darwin not know, or suspect, that the stories were nothing more than travellers' tales? Or did Darwin, in his turn and with tongue in cheek, publish the stories, knowing that many uncritical readers and fire-side travellers would fail to see the significance of the date with which he opened his account?

Note: Professor Ernst S. Reese, Department of Zoology, University of Hawaii at Manoa, is presently working on a monograph and annotated bibliography on *Birgus*, while on sabbatical leave at the National Zoological Park, Smithsonian Institution, Washington, D.C.

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*Principes*, 27(3), 1983, p. 137

## PALM LITERATURE

### Coconut Product Development

Although often overshadowed these days by the more economically important oil palm, the coconut still furnishes the widest array of commercial products of any palm species. Development of new coconut products and technology has been the objective of the International Coconut Development Associations (ICDA), located in Stockholm. In 1978 it began a quarterly publication, *International Coir Development Newsletter*, devoted to research, industrial processing, and marketing of coir fiber. By its second year, articles on other coconut products were added and this led in 1981 to the adoption of the new name *Coconut Industries*. This periodical is now devoting most issues to feature topics such as coconut for food, coconut energy, or coconut oil, along with general information from other publications, industrial news, production figures, trade inquiries, and so forth. For anyone involved with the coconut industry, or interested in following future trends, this represents an indispensable source of current information.

The ICDA also is distributing two other documents issued in 1981. A 44-page report entitled "Coconut Fibre in Swe-

den," was prepared to promote the import of products from developing countries. "Introduction to Integrated Processing of Coconuts," 99 pages, is a comprehensive plan, designed by Scarab Development AB, for the simultaneous processing of coconuts to obtain oil, food products, coconut water, fiber, and charcoal.<sup>1</sup> This integrated processing procedure would increase both productive employment and export earnings in the countries where the coconuts are grown. Adoption of this technique on a large scale could signal the beginning of a new era for this palm which has so often been called the "tree of life."

A subscription to the periodical may be obtained for 20 pounds sterling per year in industrialized, and for 7 in developing countries. The first report is free of charge except postage and handling, the second costs \$75 to subscribers. All can be ordered from ICDA, Box 7605, S-103 94 Stockholm, Sweden.

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<sup>1</sup> Integrated processing of coconuts in the Philippines was advocated by Vicente D. Gabriel, Sr. in *Progress and Prosperity in the Coconut Industry*, Philippine Inventors Commission, 1976, 56 pp.