

evolution (ev-ol-ú'shun, é-vo-lú'shun) n.



coral (kó-rál) n. a hard, fleshy substance growing on the bottom of tropical seas, and composed of the skeletons of invertebrates; the commonest variety is reddish; yields a very important source of lime. coral (kó-rál) n. a light-red colour; a pinkish sea-weed (the sargassum).

Charles Darwin



# A Laboratory of Islands

## CHARLES DARWIN'S PACIFIC PROJECT

» IAIN McCALMAN



stall (stól, ó-tól) n. a ring-shaped coral reef surrounding a lagoon (Native).

The prospect of leaving the Pacific coast of South America at the end of 1835 darkened Charles Darwin's mood. Now he would be unable to take long inland excursions to escape chronic seasickness. Confronted with the vastness of the Pacific on the *Beagle's* final leg, he felt homesick. His body had been weakened by a mysterious illness at Valparaiso and the Pacific swell somersaulted his delicate stomach. He felt irritated by 'the want of room, of seclusion, of rest — the jading feeling of constant hurry — the privation of small luxuries, the comforts of civilization, [and] domestic society [...]'. The Pacific Ocean loomed like 'a tedious waste, a desert of water'.<sup>1</sup>

This fatigue would taint Darwin's aesthetic appreciation of some of the Pacific and Indian Ocean lands he was to visit — just as it has dulled the evaluations of some historians. With the exception of Darwin's visit to the Galapagos Islands in October 1835, which is often misunderstood, it is frequently assumed that his achievements were over once the *Beagle* headed south for Tahiti. Yet in a letter to his naturalist cousin Henry Fox, Darwin anticipated visiting the Galapagos, Tahiti and Sydney 'with more interest than anything in the whole voyage'. He expected important new insights to come among the islands and island continents of the Pacific and Indian Oceans, and he was right. The Galapagos proved to be the preamble to an integrated sequence of explorations that opened up new

horizons of knowledge and speculation. He knew that the Indo-Pacific islands would be good to study because of their manageable size, their recent origin as landforms, habitats and societies, and their fascinating organic relationships with continental neighbours.

In this short essay I'd like to survey the Indo-Pacific component of Darwin's voyage, outlining a key set of problems he set out to analyse, and the results of his experience. I argue that the Pacific laboratory set him on a path to developing his theory of evolution by natural selection and his associated understandings of the operations of the 'natural economy' — what we today call ecology.

Two thinkers had furnished Darwin with a new set of methodologies and theories for exploring the lands of the Pacific and Indian Oceans. Alexander von Humboldt's massive South American survey, *Personal Narrative of a Journal to the Equinoctial regions of the new Continent* (1799-1804), had taught him that the aesthetic pleasures of the Romantic traveller and the intellectual satisfactions of the empirical scientist were complementary. Humboldt believed that the intuitive 'inner sense' of a sympathetic cultivated mind might grasp the unity hidden beneath nature's physical and organic diversity. To Humboldt, nature functioned as a harmonious and integrated system within which man shared a sympathetic place. Conflict and violence had little or no part to play.



(above)  
Cocos Keeling Crab.

COURTESY OF  
KIM MCKENZIE.  
MONTAGE ENGRAVING  
SOURCES: WIKIMEDIA  
AND PICTURE BOOK  
OF EVOLUTION,  
C.M. BEADNELL (1932)  
WATTS & CO., LONDON.



(left)

The first page of a letter written by Charles Darwin to his friend Charles Whitley from Valparaiso, 23 July 1834, one of the hundreds of letters that Darwin wrote onboard the **Beagle** – his only form of communication with friends and family back home.

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Humboldt also believed the naturalist should train himself in analytical methods so as to map the geographical and environmental conditions that shaped how plants, animals and humans lived. Conditions of soil and climate created

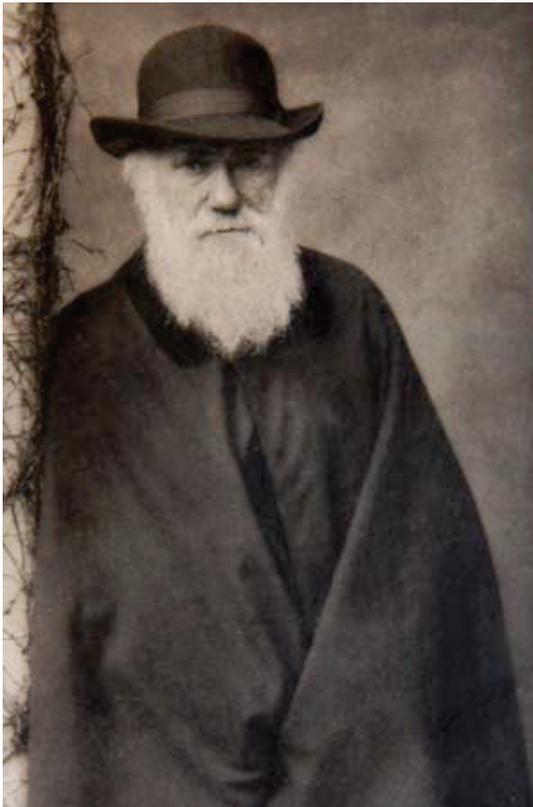
a Lyellian geologist, he said, 'altered the whole tone of one's mind, and therefore [...] when seeing a thing never seen by Lyell, one yet saw it partially through his eyes'.<sup>2</sup> Through these eyes, Darwin had come to see geological change as a gradual but ceaseless historical process. Even geologists who discounted the earth's Biblical time-span of four thousand years tended to assume that continents had been shaped relatively quickly by cataclysmic supernatural events like the Flood. Lyell argued, however, that the same slow everyday forces of wind, rain, ice and sun 'now in operation' had sculpted the earth's form over eons of time.

Lyell believed that divine creation had triggered this machinery of geological change, but he insisted that geologists must use only observable natural laws to explain how these

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(below)

Portrait of Charles Darwin.



distinct, interdependent, environmental regions across the globe. These regional features could be measured with objective instruments like barometers and clinometers and then mapped using mathematical techniques such as vertical and horizontal grids. Comparing the resulting data would produce a global picture. When the intuitive Romantic evaluation was combined with these objective empirical measurements a holistic understanding of the natural economy was possible.

At the same time Darwin was devouring Charles Lyell's brilliant *Principles of Geology* (1831-33). Becoming

changes operated in the world. To do otherwise was unscientific. The vast age of the earth had, for example, enabled slow persistent movements of the earth's crust through volcanic eruptions or earthquake fractures to produce successive rises or falls in the height of surrounding land.<sup>3</sup> '[T]he solid earth', Darwin wrote excitedly in his diary, 'considered from our earliest childhood as the very type of solidity has oscillated like a thin crust beneath our feet'.<sup>4</sup>

Along with Lyell, Darwin still believed that nothing could alter the fixed biological character of species, which remained essentially immutable from their moment of divine creation. True, alterations in physical environments might cause some species to perish or to move to new habitats. Here, too, the latter might develop slight variations of structure or behaviour in response to new conditions. But Lyell stressed that these changes could never produce permanent transmutations. Variations would disappear over time as a result of inter-breeding among wild populations.<sup>5</sup>

At the same time Lyell introduced Darwin to the idea that nature was 'a struggle for existence', not only between predators and their prey, but also between individuals within a species. This view would later be reinforced

by reading Thomas Malthus on the tendency of populations to outstrip resources and so to generate a perpetual struggle in the social world. Furthermore, Darwin understood from Lyell that man could be a violent and disruptive agent within nature's economy — albeit on a small scale when compared with geological forces.

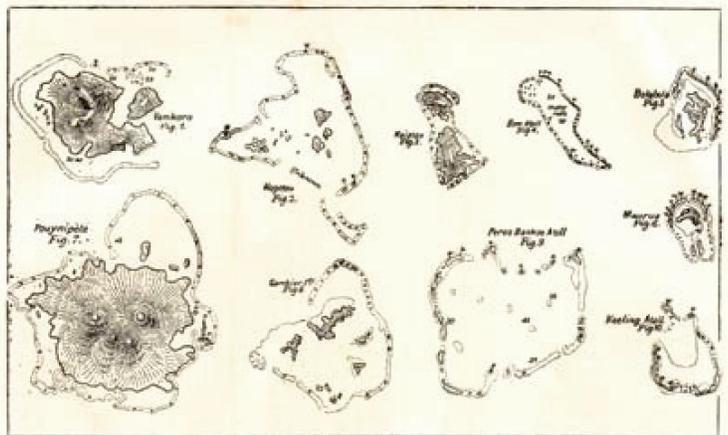
This Lyellian view of nature as struggle clearly clashed with Humboldt's conception of nature's harmony; and for some time Darwin oscillated between these conflicting positions. Even so, the two thinkers gave him a loose collective agenda for his investigations in the Southern Oceans. Indo-Pacific islands, with their confined habitats, would, he believed, simplify the task of collecting comprehensive biotas and mapping plant, bird and animal interactions. The 'uniformitarian' insights and methods of a Lyellian geologist would enable him to investigate both the physical origins of islands and the ways that new land masses could become populated by invasive species, which in turn generated new networks of flora and fauna by adapting to local climatic and soil conditions.

As well — and here Darwin's agenda was as much influenced by his assessments of Fuegian natives in Patagonia — he would explore how these processes of migration, dispersal and adaptation could influence human populations and societies. In particular, he'd observe how new influxes of peoples, or 'invasive species', often from 'civilized' northern centres such as Britain, had influenced the original 'primitive' inhabitants of southern islands or continents and reshaped their natural environments.

Finally, Lyell had set Darwin thinking about how coral reefs were formed. Knowing that corals could survive only in shallow water, Lyell thought that their polypi grew on top of underwater volcanos elevated from the sea bottom. But Darwin thought this theory failed to explain the different forms of the three prevalent coral reef types: barrier reefs that arose some distance from the shore; fringing reefs that grew around volcanic islands; and atoll reefs that formed a ring or horseshoe shape, with a lagoon nestling inside and drifts of sand and dead coral forming a new 'coral island'.<sup>6</sup> While observing the vast land elevations on the west coast of South America, Darwin had wondered if there could be a

corresponding subsidence elsewhere on the seabed. Might this explain the variety of coral reefs and islands that studded the Pacific and Indian Oceans?

In short, the *Beagle's* leg of voyaging among the islands, archipelagos and island continents of Oceania offered Darwin a set of unique living laboratories for testing his emerging knowledge and skills as a theorist of geology, zoology and ethnography. And,



though he did not know it at the time, the results of these island investigations would push him several steps closer to a theory he would one day call 'modification by descent through natural selection'.

When the *Beagle* arrived at the Galapagos Archipelago on 15 September 1835, after sailing some six hundred miles west of Ecuador, Darwin decided that it resembled 'a new creation',<sup>7</sup> but of a strangely infernal kind. At Chatham Island, the blackened coast reminded him both of industrial Wolverhampton and of Milton's *Pandemonium*. The beach and hinterland were littered with broken lava heaps and scorched boulders. Scraggy plants struggled like weeds among the clinkers. Volcanic craters pitted the ground at every point — more than two thousand of them.<sup>8</sup>

Despite all that he'd read Darwin had not expected organic life on the Galapagos to be so bizarre that it appeared to come from another planet. He couldn't imagine what centre of divine creation could have produced such a diabolical array. Some birds and plants he recognised as having South American affinities, but what were penguins doing among the overgrown lizards in this tropical habitat?



(above)

A cross-section of coral reefs used to illustrate Darwin's coral reef theory. From *The Structure and Distribution of Coral Reefs* by Charles Darwin, 1842.

COURTESY OF PETER FULLAGAR.

And why had the creator, whose exquisite designs Archbishop Paley had outlined in his Cambridge textbook, chosen to create a paradise for reptiles? There were tortoises that needed eight men to carry them, and ‘disgusting clumsy lizards’, or iguanas, that Darwin called ‘imps of darkness’. One species of iguana fed off the land; the other grazed on underwater seaweed — as he proved when he dissected its stinking guts on the poop-room table. In the interests of science he repeatedly threw a sea-going specimen into the water to find out whether its instinct was to return to land. Sure enough, the creature patiently clambered back on shore each time, implying that it had adapted itself to finding aquatic food. Darwin could see that these Galapagos reptiles were fulfilling the role of mammals in other parts of the world, but why?

The strangeness of the plant and animal life galvanised him into a collecting frenzy.

that mockingbirds on Chatham, Charles and James Islands were each ‘consonant with its own island’.<sup>10</sup> Even so, these observations were perfectly compatible with creationist beliefs that small, temporary variations could arise from local adaptations. All in all, when the *Beagle* set sail for Tahiti on the 18 October 1835, Darwin’s satisfaction came less from any fresh natural history insights, than from the volume of his collections.

For the next twenty-five days the *Beagle* surfed ‘the boundless ocean’ until, on Sunday 15 November, they came in sight of Tahiti, ‘an island’, Darwin noted, ‘which must forever remain as classical to the Voyager in the South Sea’.<sup>11</sup> Darwin didn’t expect to find many new specimens either here or in New Zealand or Australia: his time on land would be short, and these three places had already been worked over by earlier naturalists. No matter. Darwin told his sister Caroline that he intended to

WHY HAD THE CREATOR, WHOSE EXQUISITE DESIGNS ARCHBISHOP PALEY HAD OUTLINED IN HIS CAMBRIDGE TEXTBOOK, CHOSEN TO CREATE A PARADISE FOR REPTILES?

On each island visited, he and his helpers shot, cut down, dug up, gathered, fished and trapped specimens from every branch of natural history. Yet they were collecting almost indiscriminately. Darwin was more interested in obtaining coverage than in recording where he found particular specimens. This oversight was to make the whole sample useless for scientific citation.<sup>9</sup> He thought, for example, that several hundred plant specimens he’d gathered were duplicates of each other, not realising they were distinct species. Neither did he know that the numerous little birds he shot — today reverently called ‘Darwin’s finches’ — were finches at all, let alone more than twenty different species of the genus. Though he noticed some differences in their beaks, he thought these to be insignificant deviations within a single large population.

Two anomalous pieces of information did make his notebooks, though he was too busy to consider their implications. Locals could apparently tell from the shape of the tortoise shells which particular island they had come from. He thought it ‘singular’, too,

write ‘much about the missionaries’ and their charges.<sup>12</sup> This focus was opportunist, but not trivial. Having seen Captain FitzRoy’s Fuegian mission collapse when the Christian Jemmy Button returned to his ‘savage’ ways, Darwin was eager to explore the further impact of missionaries on native peoples. He proposed to undertake comparative investigations of how agents of English ‘civilization’ — settlers and missionaries — were influencing the original ‘primitive’ inhabitants of each island and creating new local environments. Having shifted his inquiries from rocks to animals at the Galapagos, Darwin was now moving to people in order to test the social and ecological impact of human ‘invasive species’.

In the fortnight that the *Beagle* spent in Tahiti, Darwin launched his ethnographic-centred inquiry. He found the Tahitians as socially and aesthetically impressive as voyager accounts had claimed. The men, in particular, showed a mild, gentle intelligence that suggested advanced civilisation. Their brown athletic bodies shamed the white men, making them seem bleached and insipid. He loved the



way their tattooed bodies were ‘ornamented like the trunk of a tree by a delicate creeper’.<sup>13</sup>

Neither did he see any signs that Christianity had crushed the natives’ spirits. The missionaries struck Darwin as more practical than pious. They and their native allies seemed to have eliminated the vices of kava drinking, alcohol, infanticide, warfare and cannibalism. The people’s traditional food sources also appeared undamaged: lush tropical fruits and vegetables still grew with wild abundance and were cooked in the delicious local manner reported by all voyagers. When the *Beagle* left on 26 November, Darwin could only add his quantum of praise ‘for the island to which every traveller has offered up his tribute of admiration’.<sup>14</sup>

Darwin spent only a few weeks at their next destination, New Zealand’s north island, where they arrived on 21 December 1835. Beginning in the Bay of Islands, he visited the nearby town of Kororareka and the missionary settlements of Pahia and Waimate. Again he concentrated almost exclusively on investigating the European impact on the Maori, but his observations here showed the effects of marked missionary bias, leading him to compare the Maori adversely to the Tahitian. The eyes of Maori warriors were ferocious, their figures bulky, their houses filthy. He could see no principle of government among and between the tribes other than violence: ‘the love of War was the one and lasting spring of every action’.<sup>15</sup> Informants told him that polygamy was common and cannibalism not yet extirpated. Overall, he placed Maoris on the scale of savagery only just above the Fuegians.

Darwin did concede, however, that missionaries had often relied on Maori people

for protection against the far worse violence of European settlers, many of them ex-convicts from Australia, who were ‘the very refuse of society, completely addicted to drunkenness and vice’. He noted, too, that settlers had razed Kauri forests for pasture and introduced devastating pests such as rats, wild leek, common dock and other weeds. Only the missionary establishments, with their English flora and manners, softened what for him was ‘not a pleasant place’, and from which he gladly departed on the 30 December.<sup>16</sup>

Just under two weeks later, on 12 January 1836, the *Beagle* entered Port Jackson and anchored at Sydney Cove. Darwin was itching to assess the character and impact of a unique convict-based British society, an invasive species like no other. Everything he saw, however, outraged his gentry sensibilities. Ex-convicts had become some of Sydney’s wealthiest men: they rode in gilt carriages and built extravagant houses. Darwin feared that the gross and sensual manners of convict servants would warp future generations and lead to an overall moral decline. It seemed an unpromising basis for a future society.

However, Darwin was deeply impressed by the indigenous inhabitants he encountered. On an excursion to the Blue Mountains, he bumped into a small party of young Aboriginal men, who with their ‘good humoured and pleasant’ countenances, and acute observations ‘appeared far from such utterly degraded beings as usually represented’.<sup>17</sup> Even so, he worried about their survival. Disease, intertribal warfare, high infant mortality and exposure to

(above left)

**Entrance of the Bay of Islands, New Zealand.** Watercolour by Augustus Earle, 1827.

NATIONAL LIBRARY OF AUSTRALIA, NLA.PIC-AN2820777.

(above right)

**Detail of The Residence of Shulitea chief of Kororadika [ie. Kororareka], Bay of Islands, New Zealand.** Watercolour by Augustus Earle, c. 1827.

NATIONAL LIBRARY OF AUSTRALIA, NLA.PIC-AN2820827.

European spirits were taking their toll. On top of this, the extinction of Aboriginal habitats by European guns, dogs and land policies had led to a struggle for existence that appeared unequal: 'when the difficulty in procuring food is increased, of course the population must be repressed in a manner almost instantaneous as compared to what takes place in civilized life'.<sup>18</sup> Though Darwin did not yet think to transfer to the zoological world these ideas of population decline through struggle, he was laying down the elements of a future

from the English water rat, whose role in the economy of nature it replicated?

A few hours earlier he'd been resting on a sunny bank, ruminating on 'the strange character of the Animals of this country as compared to the rest of the world'. At the time he'd been thinking particularly about parrots — birds so strikingly unlike any in England. On the other hand he'd also seen Australian crows and magpies that closely resembled their English counterparts. What did all these contradictions mean? Seeing an ant-lion similar,

though smaller than its northern hemisphere counterpart, he imagined a dialogue between two opposing viewpoints. One hypothesised separate creators in each hemisphere. The other, 'an unbeliever in anything except his own reason', contended that Australian and English ant-lions must have come from a single mind, though Darwin did not specify whether it was a divine or natural one. True, either viewpoint could have come from a Christian creationist, but Darwin's dialogue suggests he was beginning to test such creationist theories and to find them wanting. None, it seems, satisfactorily answered

the problems posed by Australian species.

Darwin's rumination also reflected his strengthening interest in the functioning and behaviour of species within the earth's overall ecology. Australian birds and animals might look different, but they shared the same 'office' or 'place' within the interdependent 'economy of nature'.<sup>21</sup> Where no closely resembling species existed to perform such 'offices', these could be fulfilled by very different substitutes, such as the reptiles of the Galapagos or the monotremes, marsupials and parrots of Australia. But why and how such species were driven to fill these vacant offices remained unclear. Ecological puzzles of this kind were insensibly edging Darwin towards an evolutionary hypothesis.

On 1 April 1836, the *Beagle* reached the isolated archipelago of Cocos-Keeling Islands in the East Indian Ocean, halfway between

theory of the survival of the fittest.<sup>19</sup> In this sense social Darwinism actually preceded zoological Darwinism. His language also suggests an awareness of the Malthusian thesis, though he is supposed not to have read Malthus's text until a year or two later.

And, as in the Galapagos, Darwin was puzzled by the weird appearance of many Australian animals, which yet often behaved like northern hemisphere equivalents. On 19 January, he openly speculated on the dangerous new subject of the origin of species. At no other time on the *Beagle* voyage did Darwin raise this question, which he would then deal with in secret for a further twenty years. Early that morning he'd shot a platypus. While swimming in the creek, it had looked and behaved like a commonplace English water rat.<sup>20</sup> Why then, he pondered, was this animal so different



(above)

**View of the Heads, Port Jackson.** Watercolour, gouache, gum, scraping out on paper by Conrad Martens, 1853, 54.2 x 76.2cm.

PHOTOGRAPHED BY DIANA PANNUCIO. PURCHASED WITH ASSISTANCE FROM OVERSEAS CONTAINERS AUSTRALIA LTD 1986. ART GALLERY OF NEW SOUTH WALES.

Australia and Africa and now administered by Australia. Darwin had persuaded FitzRoy to make this visit so he could test a theory that had been buzzing around in his mind for six months.<sup>22</sup> He speculated that a series of slow subsidences had taken place in various parts of the Pacific with which coral growth had kept pace, thus enabling the coral to be continually immersed in shallow water where it had enough light to grow. Live coral thus rested on layered ramparts of dead coral unable to survive in the inky deep water.

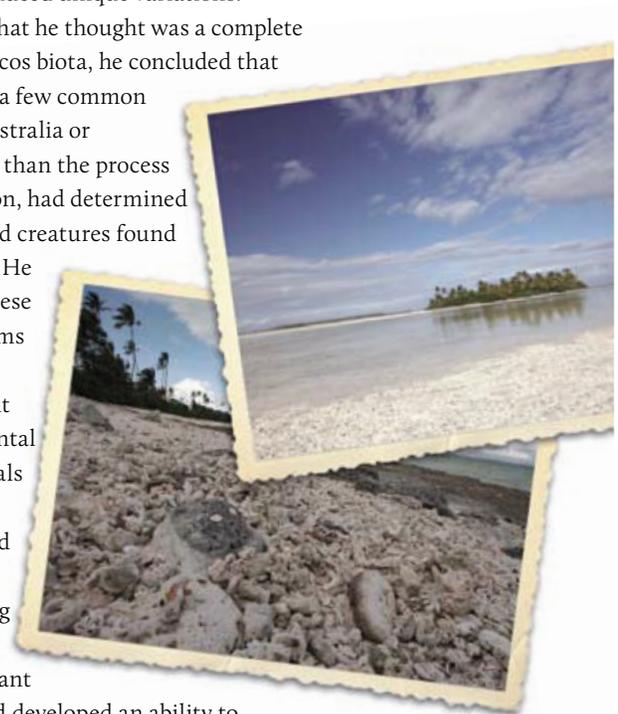
Over the next ten days Darwin waded in the lagoon shallows to collect the delicate corals of the inner reef and vaulted with a pole to reach the outer reef's margins where waves crashed violently. Here, as he'd hoped, exposed coral cells had died from the effects of the sun, but those bathed by the sea were living. He and FitzRoy also took soundings immediately outside the atolls using a 7200-foot line that found no bottom. This suggested that the reef had formed a vast submarine mountain with sides steeper than a volcanic cone.<sup>23</sup> It followed, as Darwin explained in his diary, that a fringing and barrier reef could become an atoll: 'In time the central land would sink beneath the level of the sea and disappear, but the coral would have completed its circular wall. Should we not then have a Lagoon Island? Under this view, we must look at a Lagoon Island as a monument raised by myriads of tiny architects, to mark the spot where a former land lies buried in the depths of the ocean'.<sup>24</sup>

When the *Beagle* sailed out of the lagoon on 12 April 1836, Darwin was elated: 'I am glad we have visited these Islands; such formations surely rank high amongst the wonderful objects of the world. It is not a wonder which at first strikes the eye of the body, but rather after reflection, the eye of reason'.<sup>25</sup> That invisible eye had generated a unique body of evidence about the ecological functioning of atolls that was to prove hardly less significant for his future theory of evolution than his earlier Galapagos visit. He saw how organisms had influenced the environment and vice versa. Tiny coral polypi had fashioned landforms on which new organic networks developed. Unlike in the Galapagos, moreover, he described exactly where he found each specimen of plant, fish, insect or bird. This

time he could test whether isolation on separate islands had produced unique variations. Having made what he thought was a complete collection of Cocos biota, he concluded that the dispersal of a few common species from Australia or Sumatra, rather than the process of divine creation, had determined which plants and creatures found their way there. He saw, too, that these refugee organisms adapted their behaviour to suit new environmental conditions. Corals had checked their growth and altered their shapes according to the strength of the waves. Giant robber crabs had developed an ability to crack open the nuts with fierce claws.

Above all, Darwin began to use metaphors of struggle to describe the perpetual battle between sea and coral: 'the ocean throwing its water over the broad reef appears an invincible enemy, yet we see it resisted and even conquered by means which would have been judged most weak and inefficient'.<sup>26</sup> All in all he had traced the process whereby a tiny organism, by purely natural means, managed to bring about a 'new creation' based on locally-adapted species that had arrived by chance at these sandy 'refuges for the destitute'. At least in this instance, no divine creator had been necessary.

With the benefit of hindsight, we can see how closely Darwin's coral reef hypothesis anticipated his later theory of evolution by natural selection. Two years before he supposedly read Malthus's book on population struggle, Darwin had already drafted the idea that populations of corals were limited by an intense struggle with forces and organisms, such as the sun, the sea, water temperature and coral-eating fishes. He was arguing, too, that physical geology, together with population growth and environmental struggle, could explain major facts of long-term geographical distribution,<sup>27</sup> a process — in



(above)

Cocos (Keeling) Islands.

COURTESY OF  
KIM MCKENZIE.

the words of another modern authority — ‘of sequential and irreversible change of form through time’.<sup>28</sup> We call this evolution.

Finally, as the *Beagle* headed for home after calling briefly at Mauritius and Cape-town, he took stock of his Southern Ocean experiences. He reviewed his notes, cross-referenced key points and made comparisons between the islands and continents he’d visited. Now he could see the archipelagos of the Indo-Pacific as an integrated and interconnected phenomenon, grasping their origins, adaptations and ecological functioning in a way he’d never been able to do in the Atlantic. New connections fired in his mind. He thought about the dispersal of species to remote islands, the effects of isolation, the pressures of environmental change, and the possibilities of varieties becoming species. Now, too, he suddenly glimpsed the significance of the fact that Galapagos tortoises and mockingbirds might be different on each island. Could they have descended from a common ancestor, then diverged? ‘If there is the slightest foundation in these remarks’, he scribbled portentously in his shipboard notes, ‘the Zoology of Archipelagos will be well worth examining; for such facts would undermine the stability of species’.<sup>29</sup> One would have to believe in some sort of theory of evolution; and Charles Darwin now did. ¶



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4. Keynes, *Darwin’s Diary*, p. 445.

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24. Keynes, *Darwin’s Diary*, p. 418.
25. *Ibid.*, p. 418.
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27. Gruber, ‘Eye of Reason’, pp. 198–9.
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29. Larson, *Evolution’s Workshop*, p. 75.