By the same Author

The Changing Landscape
Discovering Ecology
Discovering Geology
Charles Darwin in Western Australia
Under the Blue Vault of Heaven:
a Study of Charles Darwin's Sojourn in
the Cocos (Keeling) Islands

Darwin's Desolate Islands: A Naturalist in the Falklands, 1833 and 1834

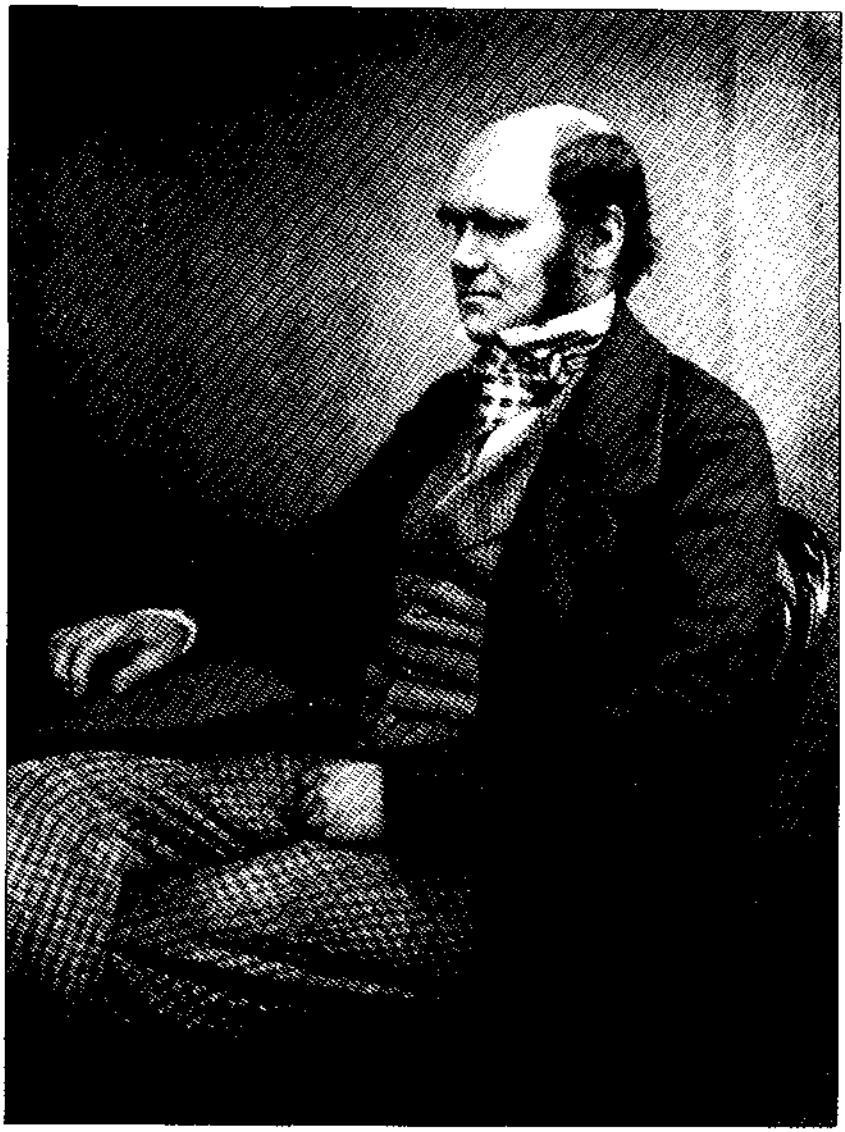
Patrick Armstrong

Picton Publishing (Chippenham) Limited
CHIPPENHAM

First published in 1992
by Picton Publishing (Chippenham) Limited
ISBN 0 948251 55 7

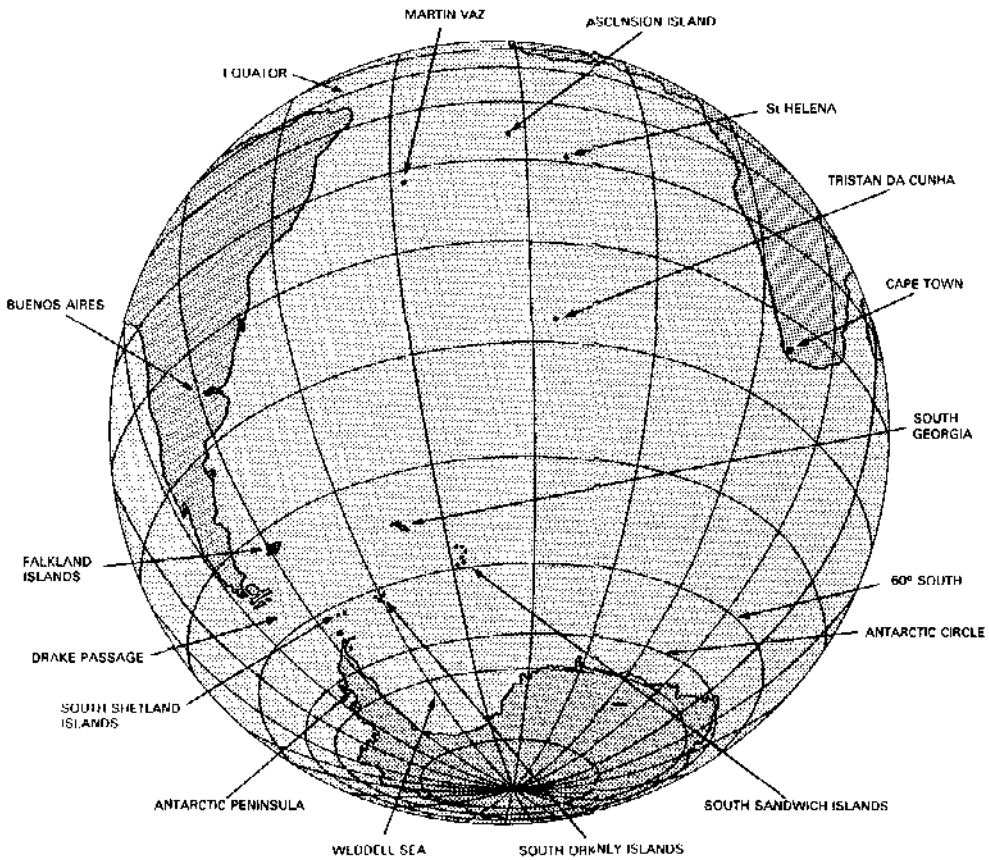
Cover Design by
Jane Brett of MIJA Design
Set in Linotype Imprint by
Mike Kelly Phototypesetting,
Biddestone, Chippenham, Wiltshire SN14 7EA
Printed and Bound in the United Kingdom by
Picton Publishing (Chippenham) Limited
Queensbridge Cottages,
Patterdown,
Chippenham,
Wiltshire SN15 2NS
Telephone: (0249) 443430

For Timothy and Alexander



Darwin in middle-life, some 20 years after his return from the *Beagle* voyage. Photograph: Copyright Down House and the Royal College of Surgeons.

Contents



The South Atlantic: Showing the position of the Falkland Islands.
Note: Cape Town, St Helena and Ascension Island were visited by HMS *Beagle* on the return voyage towards England in 1836.

Introduction

Charles Darwin's two sojourns in the Falkland Islands, in March–April 1833 and March–April 1834, have received scant attention in comparison with the detailed discussion that has been accorded certain other sections of the *Beagle* voyage, particularly the visit to the Galapagos Islands (September – October 1835) and those visits associated with the development of the Coral Atoll Theory during the crossing of the Pacific and Indian Oceans (November 1835 – May 1836). Richard Grove, in 1985, working largely from published material, emphasised Darwin's reaction to the disturbed political situation regarding the islands, and also suggested that the Falklands provided something of a "trial run" for later observations in the Galapagos, hinting that there was "an evolutionary drift to his thoughts, even during the first Falklands visit".[1]

Frank Sulloway (1982, 1983, 1984) has doubted this, emphasising that although material from the Falklands did play a role in the subsequent development of Darwin's evolutionary ideas, it was only long after the islands had been left behind that the Victorian naturalist fully appreciated the significance of some of the things he had seen.[2]

The purpose of this work is to document the chronology of Darwin's stay in the Falklands, using unpublished as well as published sources, to explore the totality of Darwin's Falkland Island experience, and to indicate that his relationship with the islands was one of some complexity. I agree with Grove that there were important themes developed from the Falklands visits that were picked up later, but, like Sulloway, I am unconvinced that Darwin's transmutation notions were developed to any extent during his visits to the South Atlantic archipelago.

Besides chronicling Darwin's doings, and inevitably therefore, to some extent, those of the crew of HMS *Beagle* as a whole, during the weeks at Berkeley Sound, East Falkland, emphasis will be placed on the significance of the biological and geological work that Darwin undertook.

The political, legal, naval and military events of the early 1830s in the Falklands will not be discussed in detail, except insofar as

they impinged on the the activities of the crew of HMS *Beagle*. The much-disputed and argued-over sequence of occupation and reoccupation, claim and counter-claim, political manoeuvre and legalistic gambit of these years are of course vital to any consideration of the sovereignty of the islands. They have been discussed elsewhere, especially since 1982. There is some evidence that Charles Darwin found this international jockeying confusing and frustrating (although not unimportant). He noted at one point: "This place . . . has been . . . a bone of contention between different nations", but he was generally happy to leave such concerns to others. So, for the most part, shall we.

Chapter 1

Techniques and Sources: Understanding Darwin's Methods of Working

Sources used

The sources used in this study included Darwin's letters (now published in *The Correspondence of Charles Darwin*, Vol 1, edited by Frederick Burkhardt and Sydney Smith, [CUP, 1985], and largely held as originals in the Darwin Archive in Cambridge University Library at DAR 223), his Geological and Zoological Diaries (DAR 32–33 and 30–31 respectively), and his field note-books now held at Down House, Kent (the Falklands observations are in the books numbered 1.14 [1833] and 1.8 [1834]).[1] Also used were the log of HMS *Beagle*, now in the care of the Public Record Office, Kew (at ADM 51/3054), the original hydrographic charts and reports of Captain Robert FitzRoy, Commander of the *Beagle*, now held by the Ministry of Defence Hydrographic Department (formerly the Royal Navy Hydrographic Office), at Taunton. The original draft of a set of Sailing Directions, prepared by Captain FitzRoy and Lieutenant (later Admiral) Sulivan between 1834 and 1839 is also held at Taunton: these incorporate a few pages of "Remarks upon the Falkland Islands particularly near the settlement of Port Louis", prepared in March 1833 by Benjamin Bynoe, Acting Surgeon of the *Beagle*.[2] Somewhat lesser use was made of the diary of Darwin's servant, Syms Covington (owned by the Linnean Society of New South Wales, and held in the Mitchell Library, Sydney, New South Wales). Reference was also made to *The Voyage of the Beagle*, which was itself based on Darwin's Journal or *Diary* (edited by Darwin's grand-daughter, Nora Barlow, and published in 1933), and also to FitzRoy's published account, "Narrative of the Surveying Voyage of His Majesty's Ships *Adventure* and *Beagle*" (1839).

Notes on some of the specimens collected in the Falklands serve to confirm Darwin's diligence as a collector (eg the notes of shells, DAR 29.3/3–6, show that at least 13 specimens were collected at

East Falkland, including species of *Chiton*, *Patella*, and a number of other gastropods). One note shows that on occasion Darwin carefully noted the habitat of what he collected: "Shells, kelp; excepting small thin bivalve on beach, March, East Falkland" (DAR 29.1/6, specimen 1029). Other types of invertebrates collected included holothurians. About 20 bird specimens were collected during the 1833 visit, and 18 during the 1834 stay – this included one specimen from West Falkland, presumably shot by someone on the *Adventure* (*see page* 32), for Darwin never visited that island. The birds taken include 3 penguins, 2 species of oystercatcher, gulls, the Falkland thrush, upland goose, vulture and caracara (DAR 29.3/11–23). A mouse was "caught near a wreck" and a "young rat" was also taken. These along with the eyes of a Falklands fox or "warrah" (present scientific name *Dusicyon australis*, although some writers, such as Ian Strange[3] use *D. actarcticus australis*) were preserved in "spirits of wine" (DAR 29.3/76). A porpoise and a fur seal seem to have been taken in nearby waters. Darwin was often careful to take notes of the colours of specimens, or parts of specimens which were likely to change or be lost by his preservation methods. The colours of the eyes of birds and the scales of fish were recorded. Other details were occasionally noted; for example he recorded that rabbit specimens (he used the scientific name *Lepus magellanicus*, although he was not convinced they were a distinct species) weighed 3lbs (1.36kg). Although there were occasional lapses, on the whole Darwin was a careful and thorough collector: a note was written in one of the small leather note-books used in the Falklands to remind himself of instructions given by his friend Professor Henslow before he left: "Henslow, importance of preserving labels"!

Many of the specimens collected by Darwin and others aboard HMS *Beagle* still exist, and some were inspected during this study. These included some 24 sheets (22 species) of herbarium specimens from the Falklands, now in the Botany School, Cambridge, where they are stored in a special "Darwin Collection"; there are another 19 herbarium sheets (18 species) at Kew. Fish specimens preserved in alcohol at the British Museum (Natural History) in South Kensington include the eel-like *Phucocoetes latitans*,[4] caught by Darwin in the kelp-beds of Berkeley Sound, East Falkland, and specimens of *Aplochiton zebra*,[5] the syntypes

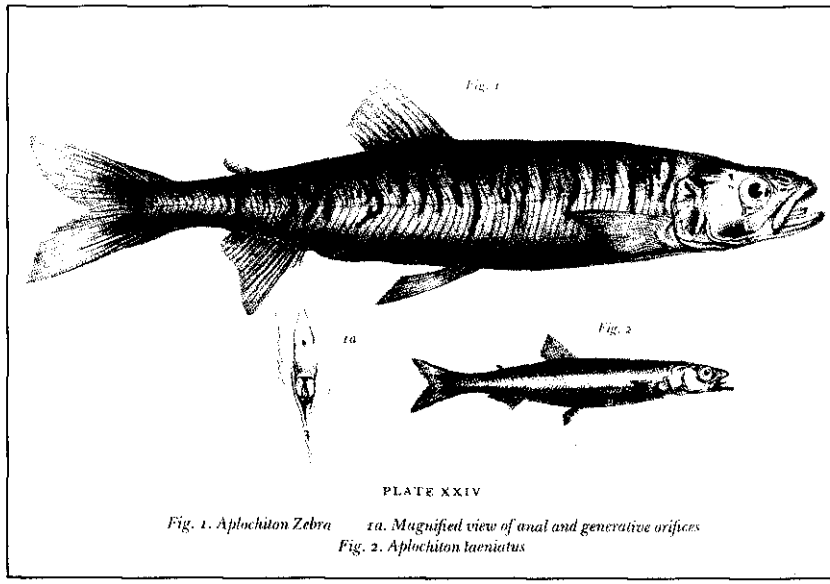


Figure 1.1. Plate from the *Zoology of the Beagle*, Part IV, showing *Aplochiton zebra*, a fish caught in the Falklands (the lower fish was caught at Tierra del Fuego).

of the Falkland trout, the well-known endemic freshwater fish the islands (caught in "a freshwater lake"), see Fig 1.1. Also in the Natural History Museum are two skins of the Falklands fox[6] donated by FitzRoy, and several skulls of this species. Numerous rock specimens were collected (now in the Department of Earth Sciences at Cambridge), and several insects – mostly small flies and beetles – many of which are in the Natural History Museum, as are the *Insect Notes* that include most of his entomological annotations made on the voyage. One of the beetles that Darwin took back from the Falkland Islands was named after Darwin by F H Waterhouse – *Phytosus darwinii*.[7]

Another "source" was the environment of East Falkland itself. I was able to visit the Falkland Islands as the result of the generosity of the National Geographical Society, and of my employer, the University of Western Australia, in February and March 1989. I attempted to locate as many as possible of the sites visited by Darwin, and to reconstruct his routes. I was in the islands at approximately the same time of year (in fact a few weeks earlier) but experienced very much better weather.

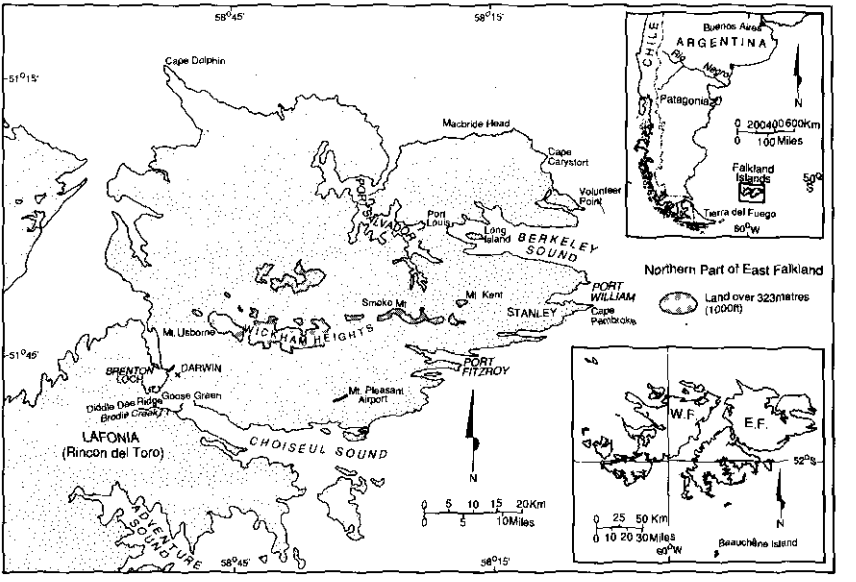


Figure 1.2 Map of East Falkland showing some of the places mentioned in the text.

It would have been impossible to fully understand Charles Darwin's relationship with the Falkland archipelago without this experience. To be able to go to a locality near the settlement of Port Louis, Berkeley Sound (Fig 1.2), and, on the basis of Darwin's notes, to be able to find within a few minutes the same types of fossils described by him almost 166 years before, heightened my appreciation of his ability as a scientific observer and recorder.

In the "little note-book" used in the field in 1834 (Numbered 1.8) appear the following jottings:

Wonderful scene of violence . . . fragments as big as churches:-

And a very few lines later:

Thrushes in flocks.

While sitting above Prince's Street, the largest stone-run in the islands, a weird and massive jumble of boulders, including "fragments as big as churches", a party of 15 Falkland thrushes (*Turdus falcklandii*), some just a few metres from away, watched inquisitively from the scattered rocks and low shrubs of the hillside while I ate my lunch. Without this personal experience I could not have appreciated how these few annotations could convey so accurately the nature of a Falklands environment.

I have previously found the combination of archive, museum, library and fieldwork techniques a useful methodology for research on Darwin's stays in a number of localities including Western Australia and the Cocos (Keeling) Islands.[8]

Much pioneer work on Darwin has utilised a single manuscript or type of manuscript (eg Nora Barlow's 1933 edition of the *Diary*, or the monumental *Correspondence*, mentioned above). The products of this research provide a set of vital tools for Darwin studies, but, however extensive the footnoting and referencing, editors can only to a modest extent show relationships to the broad sweep of Darwin's work. Other workers have concentrated on a particular incident in Darwin's life such as the "conversion" to an evolutionary outlook,[9] or the "bolt from the blue" (Wallace's letter of 1858), bringing a wide range of archive and published materials to bear on a particular problem.

Few previous enquirers have "taken the archives to the field", and made exhaustive use of all available archive and published materials written by Darwin in the elucidation of his reaction to a particular locality or set of sites. To examine a rock exposure that Darwin described, to wander along a sea-shore from which he collected shells, to photograph plants within a few metres of where he collected his own specimens, enables an enquirer to "enter the mind of the subject" to a greater extent than the scholar confined to the muniment room or library. Without experience on the ground it is difficult to fully understand the relationship between the subject and his environment, and without a least a superficial knowledge of the plants and animals, rocks, fossils and landscapes described in Darwin's works, mistakes can be made.

During my visits to localities studied by Darwin, I have had photocopies of some of the more important manuscripts in hand (on East Falkland I had some of his unpublished geological memoranda) along with published extracts from the *Diary*, the *Voyage of the Beagle*, and Captain FitzRoy's account. I also used modern topographic maps to locate sites that he examined or from which he collected specimens. Where possible, I have photographed some of these sites. My field visits are always preceded and followed by intensive work on all available archival and published sources bearing on a locality.

Sometimes letters and annotations from much later in Darwin's life throw light on his observations and thoughts during earlier

experiences of archipelagaic environments, but such material has to be interpreted with caution.

Thus as many as possible of the documentary sources, published and archive, were used in this study: it was sometimes found that these complemented one another, for a detail omitted by Darwin might be found in the writings of FitzRoy, Covington or Bynoe. And difference sources, of course, record quite different types of detail; manuscript hydrographic charts, the ship's log, letters, diaries, scientific notebooks all contain different types of information. The details recorded can mean far more when considered in relation to one another than in isolation; for example Darwin's diary may show where he was at a particular time; his specimen notes or "Geological Account" may say what he was doing there; a scrutiny of his later published writings may give clues as to the long-term significance of the experience in his intellectual development.

A perception approach

The investigation of how individuals and groups see, or saw, landscapes and environments was taken up with some enthusiasm by geographers in the 1950s, 1960s and 1970s. Professor S W Wooldridge in his regional memoir on *The Weald* (Collins, London) in 1953 urged those who would interpret human actions in a landscape to get "into the minds and reconstruct . . . the thoughts of the men who so acted." David Lowenthal developed this approach in 1961. In an important article[10] he described the way in which persons from contrasting cultures, age groups and psychological backgrounds saw the world differently:

> Each of us warps the world in his own way and endows landscapes with his particular mirages

And the relationship is two-way; experience of a landscape conditions an individual's attitudes to it thereafter. Lowenthal quoted H M Tomlinson:

> Quite often, our first impression of a place is also our last, and it depends solely on the weather and the food.

It may well be that the awful weather, and the generally difficult and rather sombre, depressing circumstances under which Darwin

saw East Falkland influenced his thinking on the environment.

Psychological or quasi-psychological studies of how individuals, especially notable artists and scientists saw the world are not unusual. Indeed Howard Gruber developed a model[11] of how Darwin's view of the world changed over time – from traditional creationist to evolutionist; Dov Ospovat's brilliant analysis of 1981[12] had similar objectives. From a content analysis (an examination of the frequency of certain words and ideas), of some of Darwin's *Beagle* letters, Sulloway[13] attempted to show how Darwin's morale and self-assurance fluctuated in part according to the work that he was doing. An extreme example of this type of study is a very recent *Charles Darwin: a New Biography* by psychiatrist John Bowlby.[14] Dr Bowlby attempts to show that the illnesses that Darwin experienced for much of his life were psychosomatic, and can be related to his experiences in childhood, and subsequent bereavements and the stresses of his scientific work.

A subsidiary theme of this present study is an examination of the way in which Darwin perceived and interacted with the Falklands environment; this we will now commence to examine in more detail.

Darwin's method of working

Darwin's method of working was both comparative and cumulative. Just before the conclusion of the voyage he wrote:

> Moreover as a number of isolated facts soon becomes uninteresting, the habit of comparison leads to generalisation,
> (*Diary* entry, late September 1836.)

The comparative technique Darwin probably assimilated from his reading of Herschel: "laws of nature" could only be shown to be valid, according to Herschel, if they could be shown to hold good again and again, under a wide variety of conditions. The following passage was scored by Darwin in his copy of John Herschel's *Preliminary Discourse on the Study of Natural Philosophy* (which Darwin had been reading in his last year at Cambridge):

> It is in the precise proportion that a law once obtained endures this extreme severity of trial, that its value and importance are to

> be estimated; and our next step in the verification of an induction must therefore consist in extending its application to cases not originally contemplated; in studiously varying the circumstances under which our causes act, with a view to ascertain whether their effect is general; and in pushing the application of our laws to extreme cases.[15]

Throughout the *Beagle* voyage, Darwin was constantly comparing his observations made in one locality with those made elsewhere, and testing his own ideas against those of others. He discussed his observations with several of his shipmates aboard HMS *Beagle*, and in his notes frequently compared his findings with those of earlier naturalists and voyagers, for the poop cabin in which he worked contained many hundreds of books.

Darwin's work was cumulative to the extent that he was constantly reworking his material, expanding it by incorporating new facts and ideas.

Thus the scribblings in his small note-book (1.14) made under the difficult field conditions of March 1833, were expanded into a ten-page geological account headed "East Falkland Isld" in the *Geological Diary* (DAR 32.21/123–131). This account is very full, sometimes including detailed descriptions of specimens, as though the brief field notes acted simply to jog the memory. It was probably written very soon after the fieldwork to which it relates. When he revisited East Falkland a year later, he re-examined some of the sites he had visited in in 1833, and also travelled more extensively. Again he recorded his field observations and thoughts in a tiny red leather-covered note-book (1.8), (and once again weather conditions were quite deplorable: his notebooks and diary are littered with references to "hail & wind", "cold wind" and "much hail and snow") but he also placed further annotations in the margins and on the backs of the pages of his earlier geological account. Another set of notes headed "1834 E Falkland Is (Appendix)" (DAR 32.2/133–150) contains not only an expansion of the March 1833 field observations, but also observations made by members of the crew of the *Beagle*'s companion ship the *Adventure* (*see page* 32), which in the course of hydrographic survey visited other parts of the archipelago than those visited by Darwin.

Yet another geological manuscript on the Falklands was clearly

written much later, for not only is it partly written on paper with an 1834 watermark, but it contains a comparison with rocks seen in New South Wales (visited January 1836), at King George's Sound, Western Australia (visited March 1836) and a reference to the Concepcion earthquake, which Darwin experienced in 1835 (DAR 33/165a–222). These indicate that it was written some time after the two visits to the Falkland in 1833 and 1834. Possibly it represents a preliminary draft for a chapter intended for Darwin's book: *The Geology of the Voyage of the Beagle: Pt 3, Observations on the Geology of South America,* but omitted when the book was published in 1846. Darwin in fact published a short article including material from these earlier manuscripts in the *Proceedings of the Geological Society* in 1846. This paper also included observations sent by Lieutenant B J Sulivan (Darwin's shipmate on the 1831–36 voyage, and a lifelong friend and correspondent) based on a subsequent period of work in the islands. Sections from the DAR 33 manuscript, for example the account of stone-runs, were also included in *The Voyage of the Beagle*, albeit in an edited form. A very limited number of illustrations must serve to show the nature of this transference and re-use of material. One of the first observations recorded in the 1833 note-book (1.14) is:

> The peat not forming at present
> but little of the Bog Plants of Tierra del F; no moss
> perhaps decaying vegetables may slowly increase it. –

This was reworked in the fuller 1833 geological manuscript as follows:

> The country is very generally covered by a bed of peat; this in some places is about 12 feet thick, & most frequently rests on a white clay bed. – When this latter was formed it is not easy to conjecture. – From the changes which are always going on, there are low cliffs composed of clay, then peat & covered by dunes of sand, all at present being destroyed by the sea. – The peat bears the signs of great age: in places the lower part is of great specific gravity. – At present I see few signs of the increase of the peat. – (a) there is but very little, in detached spots, of the Tierra del [Fuego] Bog plant, & no pools with moss. – the poor wiry grass adds a little to the moss, but it never could have formed such thick beds. – Circumstances at some former period

must have been more favourable to the growth of peat-forming plants. (b)

(DAR 32.2/132)

The 1833 document bears the following annotation on the reverse of one of the pages:

(b) 1834 March. My opinion is altered. I believe the Peat to be formed very slowly, from the grass & other plants, now growing at the surface – I think so from seeing bones in or lying on the grass, becoming partially enveloped; & from observing how extraordinarily favourable the climate is to the production of this substance. Even at the sides of the stream of fragments [ie a stone-run] where there must be such perfect drainage, peat is beginning to grow. – Likewise in the very centre, where two or three blocks lie pretty close an island will commence to form.

In the post-1836 version the account had become:

The whole surface of the land is covered by a thick bed of peaty soil or peat. In a part near the settlement it attained a thickness of twelve feet; the lower parts of the peat were extremely heavy & compact and bore signs of great age. The more fibrous kinds, not so deep below the surface are dug for fuel. The peat very commonly rests on a white clay, the origin of which latter substance is rather ambiguous. I was also at first much surprised at the quantity of the peat; those species of plants which in Tierra del Fuego are most efficient, do not here abound, nor as in Europe, are the pools filled with living mosses. From the manner in which bones of cattle, strewed on the surface of the ground are being enveloped, it appears that the coarse grasses themselves, & a few other plants, are the sole agents. I should think that no where could be found a climate so favourable to the production of peat; even the edges of masses of angular fragments this substance is rapidly expanding its spongy covering. The sides & bottoms of all the small streams are scarcely passable on horseback from the same cause. – The protection from wear & tear, thus afforded to the underlying rocks, must be more complete than perhaps in any other situation.

No mention of peat accumulation appears in the 1846 paper.

The peat example has been quoted in some detail, as it illustrates several aspects of the way in which Darwin worked, for example:

1. The careful observation
2. The strongly comparative treatment
3. The deductive approach; Darwin was constantly attempting to make deductions concerning origins and modes of formation from his observations
4. The emphasis on *process* and *change*
5. The manner in which ideas are refined and altered with each reworking as further evidence is gleaned
6. Darwin's willingness to change his mind, and also to exclude material if he felt it to be unsatisfactory or unconvincing.

The cumulative and comparative approaches also characterise Darwin's work in other fields of natural history. Darwin, after his return to England, co-operated with other scientists in the production of the *Zoology of the Voyage of the Beagle* and it is possible to trace the reworking of some of his *Beagle* notes all the way though to published volume. For instance, annotations from the "little note-books" were expanded in the *Zoological Diary*, then reworked in the *Ornithological Notes*, which have been dated to about June 1836, and then reappeared in Volume III – the *Birds* volume of the *Zoology of the Voyage* (John Gould and C R Darwin, 1841; see Fig 1.3) and eventually found their way into Gould's *Birds of the Falklands* (1854). Some descriptive notes on the Falklands fox or warrah made by Darwin in 1834 (DAR 29.1/22–23) are substantially similar to the account of that animal in Volume II of the *Zoology of the Voyage of the Beagle: Mammals*, edited by George Waterhouse and published in 1839. Similarly, descriptions of the fish compiled by Darwin (sometimes giving colours that were lost when the specimen was preserved in "spirits of wine") were utilised by Leonard Jenyns in the Fish Volume, No IV. Jenyns' published accounts of the *Beagle* fish can thus be compared with the original specimens (*see* page 2), Darwin's notes, and his (Jenyns') own manuscript descriptions of the fish, now held in the Zoology Museum in Cambridge.

There is one further aspect of Darwin's writing to which brief reference will be made. Despite their somewhat crude presentation and appearance, and the fact that most of them were never in-

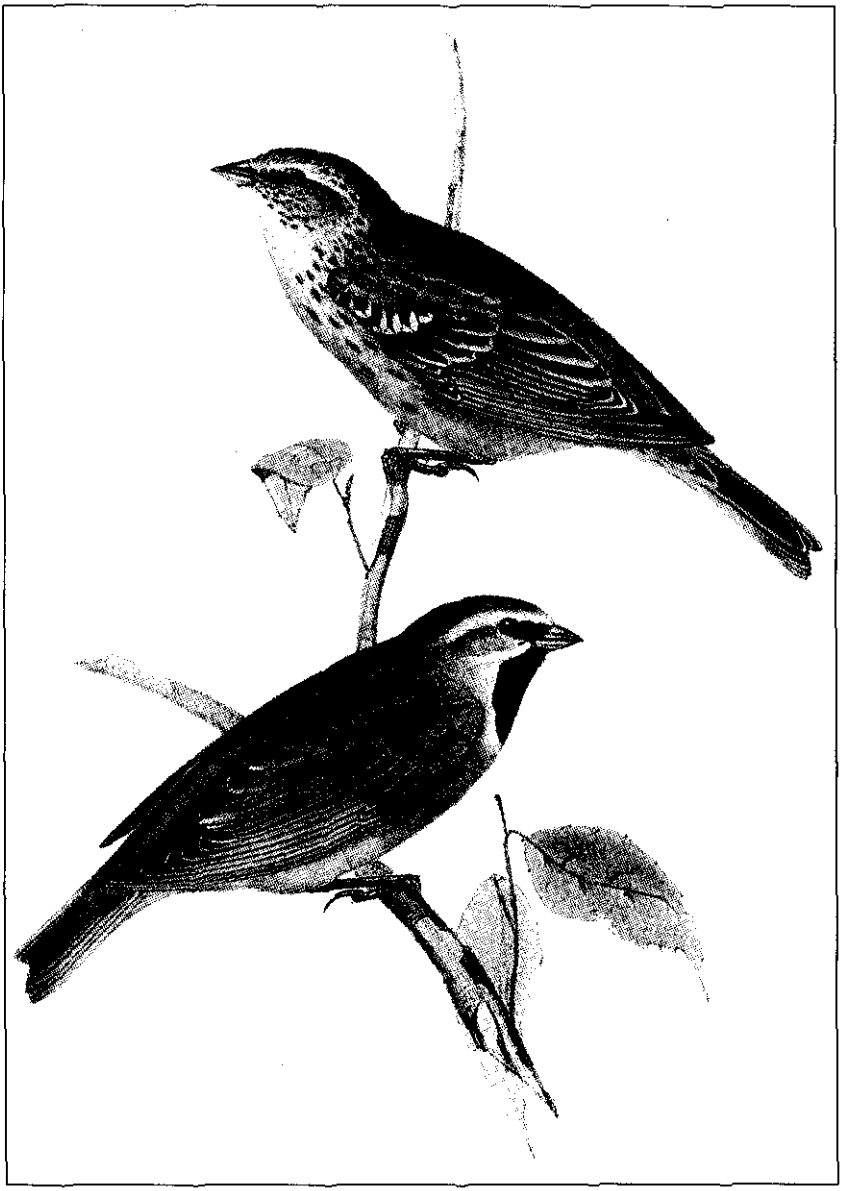


Figure 1.3 *"Chlorospiza? melanodera"*, from the *Zoology of the voyage of the Beagle*, Part III. (The modern scientific name of this species is *Melanodera melanodera*, The black-throated finch.)

tended to be seen by anyone save himself, some of the manuscripts display a somewhat rhetorical style. Phrases such as "Can we doubt that . . . ", "We may feel certain that . . . ", "What must we say to . . . " and "We are driven to suspect that . . . " recur throughout the notes from the *Beagle* period. This approach is also seen in later writings on the mutability of species, such as the preliminary draft, the *Sketch of 1842*, the more expansive *Essay of 1844*, as well as *On the Origin of Species*. There are certain literary mannerisms, as well as "thought forms" that run through almost the entire corpus of Darwin's work.[16]

Darwin the collector and observer

Ever since he had been a lad wandering in the Shropshire countryside, Darwin had collected beetles, and as a young man he had become quite expert in finding new methods of obtaining them. The following incident from his *Autobiography* gives an indication of what Darwin called his "passion" and "zeal" for collecting:

> 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 new kind, which I could not bear to lose, so I popped the one I had 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.[17]

He admits that as a schoolboy and undergraduate his collecting of insects was somewhat aimless: "for I did not dissect them, and rarely compared their external characters with published descriptions . . ." But, as the descriptions of his specimens mentioned earlier show, aboard the *Beagle* he was rather more systematic. Professor Henslow,[18] had taught him the importance of careful labelling and note-taking; usually a number or "ticket" was placed on the specimen, details of when and where it was collected being recorded in separate series of notes. Rock specimens were briefly described in red, cloth-covered note-books. Birds, fish, shells etc were recorded on separate loose pages. Plant specimens had tie-on tags attached to them.

Darwin had a certain amount of specialised equipment, including separate insect-nets for sweeping through grass on land and

for use in aquatic environments. Insects were also sometimes taken directly into pill-boxes, but sometimes "fly-nippers", presumably some form of tweezers, were used.[19] No opportunity was missed: parasitic insects were collected from bird and mammal specimens (usually shot, often by his servant Syms Covington),[20] and carrion and animal dung were frequently inspected. The *Insect Notes* show that what Darwin calls a *Catops* beetle (now known as *Falklandicus turbificatus*) was found "under old dead calf: far in country", almost certainly on the excursion to what is now the Darwin-Goose Green area, 16–19 March 1834, (*see page* 49). Another beetle, a "Sphodrus with four indistinct orange spots on elytra [the hard protective fore-wings]" was found under a dead bird on the sea coast, also in March 1834: the two specimens of this creature are still in the British Museum, and were given the name *Lissopterus quadrinotatus* by George Waterhouse in 1843.[21] Seine nets were sometimes employed for fishing. Traps seem to have been set in some places for small mammals, the mouse and rat mentioned above probably being caught in this way.

Other equipment frequently in use during the visits to the Falkland Islands would have included his geological hammer, compass, and clinometer (an instrument for determining the dips of rock strata). Moreover, it is clear that he was extremely skilled in using these items. Darwin was endowed with the ability, so important for those who would excel in geology, to see in three dimensions. He frequently used the techniques of the linear transect and cross-section drawing in his notes and geological publications, and a reading of his *Autobiography* provides a clue of where and when, and by whom, he was trained in these methods:

> As I had first come up to Cambridge at Christmas, I was forced to keep two terms after passing my final examination, at the commencement of 1831; and Henslow then persuaded me to begin the study of geology. Therefore on my return to Shropshire I examined sections and coloured a map of parts round Shrewsbury. Professor Sedgwick[22] in the beginning of August intended to visit North Wales to pursue his famous geological investigation amongst the older rocks, and Henslow asked him to allow me to accompany him. Accordingly he came and slept at my Father's house. . . .
>
> Next morning we started for Llangollen, Conway, Bangor and

> Capel Curig. This tour was of decided use in teaching me a little how to make out the geology of a country. Sedgwick often sent me on a line parallel to his, telling me to bring back specimens of the rocks and to mark the stratification on a map. I have little doubt that that he did this for my good, as I was too ignorant to have aided him. . . . At Capel Curig I left Sedgwick and went in a straight line by compass and map across the mountains to Barmouth, never following any track unless it coincided with my course. I thus came on some strange wild places and enjoyed much this manner of travelling.

Darwin used, in his geological explorations in the Falklands, almost every aspect of what he learnt from Sedgwick and taught himself that summer in North Wales: the direct transect line across country, the inspection of sections or exposures, the marking of the stratification on a map, the collection of rock specimens, the use of a compass. Darwin regretted his "incapacity to draw", and certainly his geological cross-section diagrams and sketch-maps are often somewhat crude: they are sufficient, however to make it quite clear that he had the knack of "making out the geology of a country" in three dimensions. Darwin has good cause to write feelingly, as he did, to his friend Henslow on 11 April, 1833, just after he had left the Falkland Islands:

> tell him [Professor Sedgwick] I have never ceased to be thankful for that short tour in Wales

The young Darwin had a microscope, and also dissecting instruments, with him in the poop cabin in which he lived on the *Beagle*. Many of the organisms he collected on the voyage he dissected, and he often examined specimens under the microscope. Although he says in his *Autobiography* that he did little or no dissection during the two years he was a rather reluctant medical student in Edinburgh (1825–1827), his quite excellent powers of observation may well have benefited from the training he received there, and at the hand of his doctor father – Robert Darwin. Occasionally some turn of phrase in the naturalist's notes reminds us that he was a *medicine manqué*.

Darwin's goal, of course, in making his painstaking observations, and in making collections, both of facts and specimens, was the search for *explanations of why things were the way they*

were. The collection of specimens, the careful observation of everything around him – plants, animals, rocks, landscapes, weather, people – was, as was shown above (*page* 7) in the attempt to adduce natural "laws", that explained the complex world about him. Again, an examination of Darwin's own copy of Herschel's *Discourse* probably provides an indication of what the young naturalist thought were guiding principles:

> . . . it must be observed that it is not possible to satisfy ourselves that we have arrived at a true statement of any law of nature, until, setting out from such statement, and making it a foundation of reasoning, we can show by strict argument, that the facts observed must follow from it as a necessary logical consequence, and this, not vaguely and generally, but with all possible precision in time, place, weight, and measure.
>
> (Page 25.)

And yet, was there not more to the young naturalist than meticulous, clinical observer, seeking after truth wherever the search might lead? His diary and letters occasionally betray his lively interest in his companions aboard the *Beagle*. He was also as capable as anyone of forming warm relationships. Although he does not seem to have met Midshipman Philip Gidley King, after the latter left the *Beagle* at Sydney in January 1836 (to go to live with his father, Philip Parker King), they corresponded fondly about their days of friendship aboard ship, looking back nostalgically to the evenings on deck when they had a yarn together. Occasionally too, his descriptions of the living things he encountered in his travels, or of a landscape, show a sense of wonder that rejoiced in the world about him, or trigger some other emotional response, rather that than of a detached observer to some incident. Consider for example this outburst, in a letter to his sister Caroline Darwin from the Falkland Islands, dated 6 April 1834, shortly after he had returned from a long cross-country ride under somewhat bleak conditions:

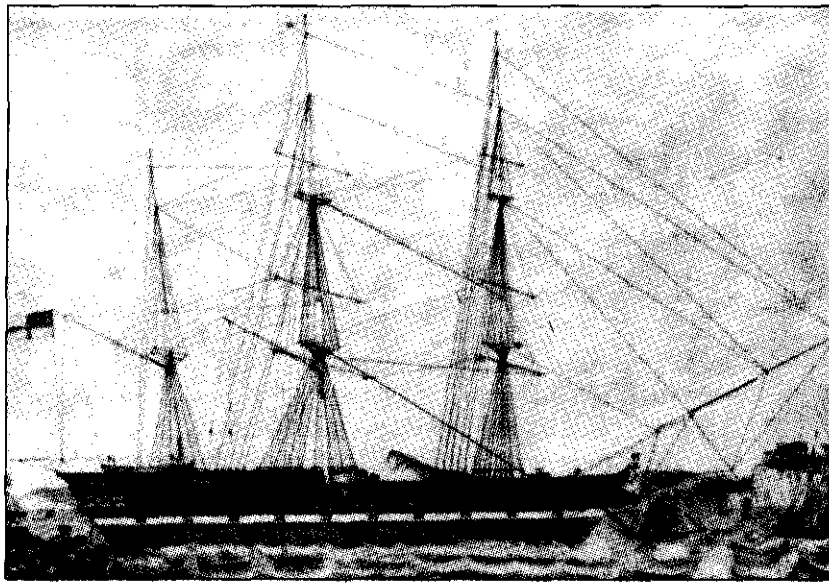
> . . . it is a wretched place: a little time since I rode across the island & returned, in four days: my excursion would have been longer: but during the whole time it blew a gale of wind with hail & snow; there is no fire wood bigger than Heath & the whole country is more or less elastic peat bog. – Sleeping out at

night was too miserable work to endure for all the rocks in S. America. –

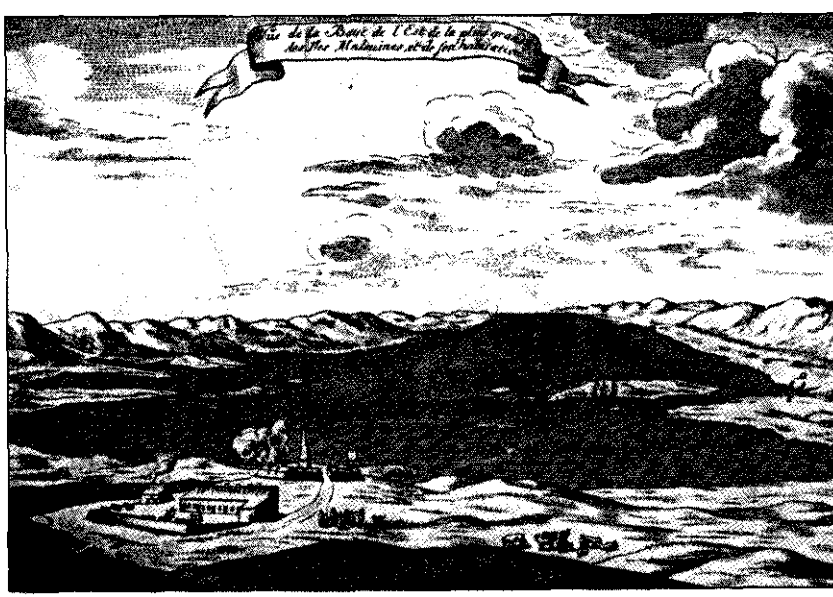
And indeed, a little later in the same East Falkland letter, we sense the tension between the keen naturalist, eager to get ahead with his work, and the young Englishman, far from home and striving to keep in contact by letter with his friends and relatives:

> Remember me most affectionately to all the Owens tell dear Fanny I do not know how to thank her, at this distance, for remembering me. – Continue in your good custom of writing plenty of gossip: I much like hearing all about all things: Remember me most kindly to Uncle Jos & to all the Wedgwoods. Tell Charlotte (their married names sound downright unnatural) I should have written to her; to have told her how well every thing is going on. – But it would only have been a transcript of this letter, & I have a host of animals, at this minute, surrounding me, which all require embalming & Numbering. –

Indeed, can we not detect a slight wistfulness as Charles Darwin writes of "dear Fanny", and in his complaining that her married name "sounds downright unnatural"? Fanny (Frances) Owen was a girlfriend of Charles and there is reason to believe he had more than a slight fondness for her. But she married a dashing young MP, a few months after Darwin set sail!



HMS *Clio*, Maritime Museum, London.



The first settlement at Port Louis, from Pernety's *Histoire d'un Voyage aux l'Isles Malouines*.

Chapter 2

The Chronology of Charles Darwin's visits to the Falkland Islands (1) The First Visit

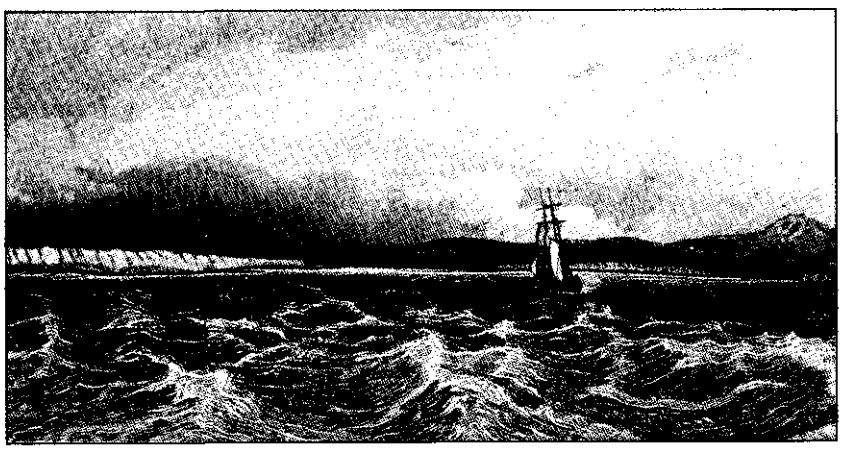


Figure 2.1 The *Beagle* at the mouth of Berkeley Sound, East Falkland, from R FitzRoy's *Narrative of the Voyage*.

In the early afternoon of Friday 1 March 1833, His Majesty's Surveying Sloop *Beagle*, in the face of a brisk west-sou'-west force five breeze was tacking up the long inlet of Berkeley Sound, East Falkland (Fig 2.1). Progress in the preceding 24 hours had been good: at noon on 28 February the little ship had been at 52° 20′ S, with Cape Pembroke 103 miles away, just a little east of north. As the *Beagle* felt her way into Berkeley Sound for the first time, the weather was fine but cold. Patches of blue sky showed through the clouds. There had been squalls and showers within the last few hours, and adjustments to the sails had been made "as requisite". At 1.30pm, sails were shortened, and the *Beagle* came to, with her bow in 10 fathoms, in Uranie Bay, on the south side of the Sound (Fig 2.2). At 2.00pm the yards were lowered, and a little later the

anchor came to rest on a shingle bottom, and the top gallant mast was struck. The weather seems to have deteriorated as the evening wore on, and was described in the ship's log as cloudy, overcast and gloomy. Around midnight and in the early morning there were further showers.

Meanwhile Captain FitzRoy, Commander of HMS *Beagle*, lost no time in making enquiries about conditions ashore:

> . . . for seeing a French flag flying near some tents behind Johnson Cove or Harbour, and knowing that in 1831, the flag of Buenos Ayres was hoisted at a settlement in the sound, it was evident that a change of some sort had occurred. Directly our anchor had dropped, a whale-boat from the wrecked whale-ship, 'Le Magellan', came alongside; and from her chief mate (who was also whaling-master), we learned that his ship had parted from her anchors during a tremendous squall on the night of the 12th of January, and was totally wrecked. He then informed me that the British Colours had been hoisted on these islands by H.M.S. Clio; and that H.M.S. Tyne had since visited the port and saluted the flag; that the white flag was hoisted at the French tents only as a signal to us; and that he was sent by M. le Dilly, his captain, to entreat us to render them assistance. Two of our boats were forthwith manned; one was sent to the settlement of Port Louis, and in the other I went to the Frenchmen at Johnson Cove. I found them very comfortably established in large tents made from the sails of their lost ship; but they manifested extreme impatience to get away from the islands, even at the risk of abandoning the vessel and cargo. After due inquiry, I promised to carry as many of them as I could to Monte Video, and to interest myself in procuring a passage for the rest.
>
> (FitzRoy's *Narrative*, 269–270)

While Captain FitzRoy was negotiating with the Frenchmen, the officer who went to the little settlement of Port Louis (Mr Chaffers) had established that:

> . . . there was no constituted authority whatever resident on the islands, but that the British flag had been left by Captain Onslow in charge of an Irishman. This man . . . soon became more loquacious than was wished.

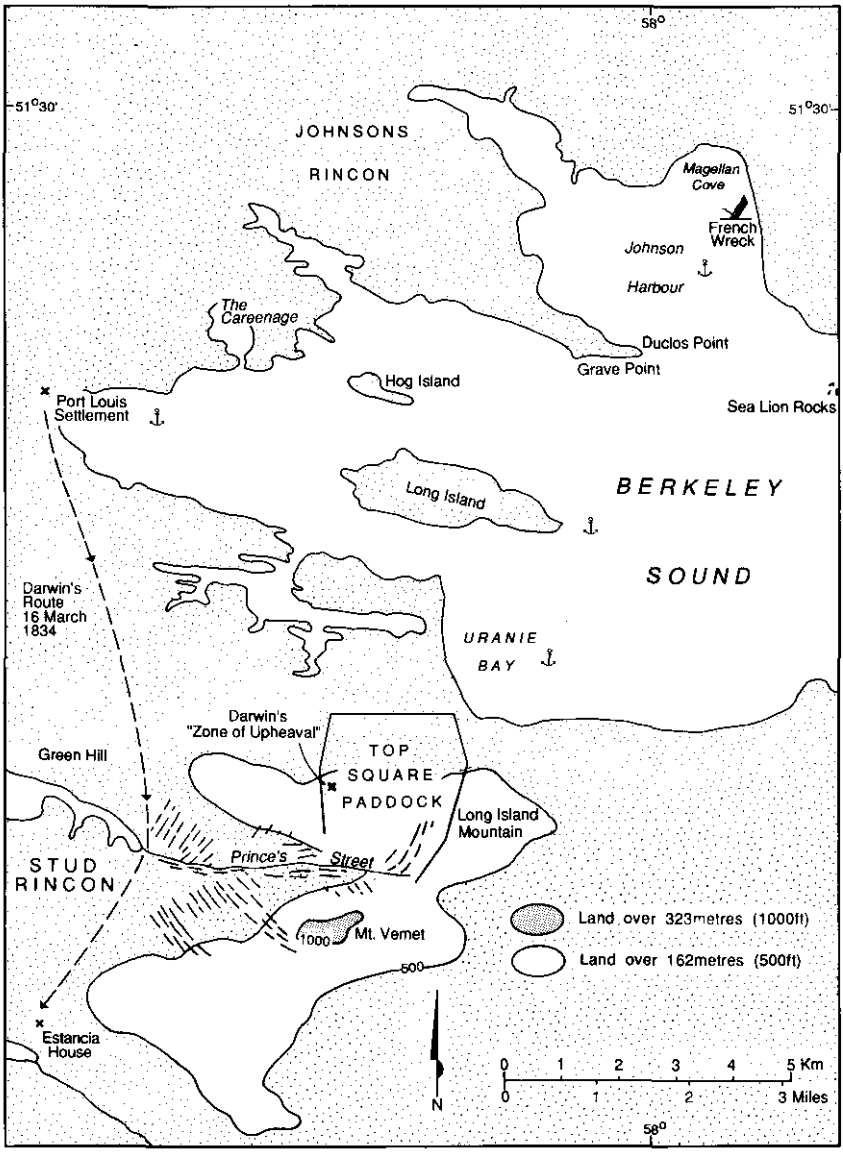


Figure 2.2. Sketch-map of the western end of Berkeley Sound, showing places mentioned in the text. The anchor symbols show the anchorages of HMS *Beagle*.

The guardian of the flag said that he had been told to hoist it when vessels came into port, and on Sundays, and reported that there was beef, and plenty of rabbits and geese to be had.

Once it had been established that there was little danger to the ship from those ashore, no time was lost in shifting her to Johnson Harbour (see Fig 2.2), closer to the wreck of the *Magellan*, the masts of which still stood. At 5.30am the following day, the wind blowing a force 4 breeze, the sky overcast and gloomy, with some rain about, the anchor was weighed and the *Beagle* moved across the sound. Later in the morning, the log reports, the weather improved, the cutter and the yawl were put out, and the crew were "employed variously about ship's duties".

These duties, for the next day or two, included getting as much as possible of the *Magellan's* stores aboard (Covington's Diary indicates and that FitzRoy also bought most of the wreck of the *Magellan* as firewood), undertaking repair work on one of the ship's boats, the gig, and commencing the task of surveying the Sound, including, in great detail, the little cove close to Port Louis – The Careenage (Figs 2.2, 2.3 and 2.4).

It seems as though Darwin went ashore on the 2 March, the first full day in the Falklands, if only briefly, for a note in one of his "little note-books" makes the comparison between the insects and plants of the mainland of South America and the islands.

On 3 March, at 9.30am, an English schooner was observed making her way up the Sound. The merchantman turned out to be the *Rapid*, fourteen days out from Buenos Aires, with a Mr Brisbane on board. Brisbane was delighted to meet the crew of the *Beagle*, for amongst her officers was one who had taken part in rescuing him from shipwreck some years earlier. Mr Brisbane, who was agent and partner of Mr Vernet who operated the Port Louis settlement, was invited on board the *Beagle*: most of the remainder of the *Rapid's* crew being in a state of drunkenness, after the difficult and hazardous voyage from South America.

While these exitements were occurring, Charles Darwin was getting to know a little more of the landscape and natural history of the area north of the Sound. He was not very impressed, but was probably away for much of the day, for he does not mention Brisbane's arrival. His diary records:

> 3rd. Took a long walk; this side of the Island is very dreary: the land is low & undulating with stony peaks & bare ridges: it is

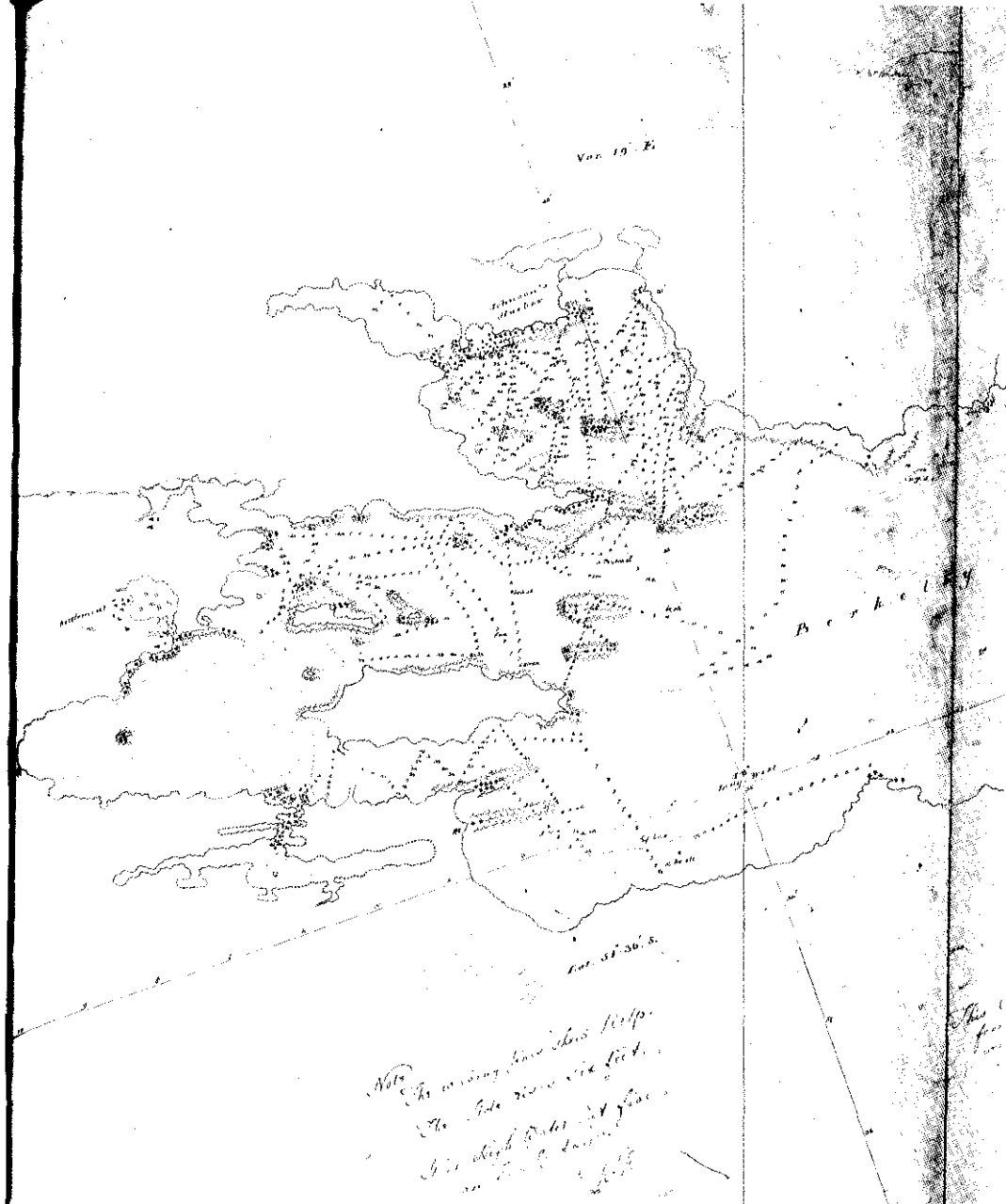


Figure 2.3. **Part of Captain FitzRoy's manuscript chart of Berkeley Sound, East Falkland.** Photograph: Hydrographic Office, Ministry of Defence, Taunton.

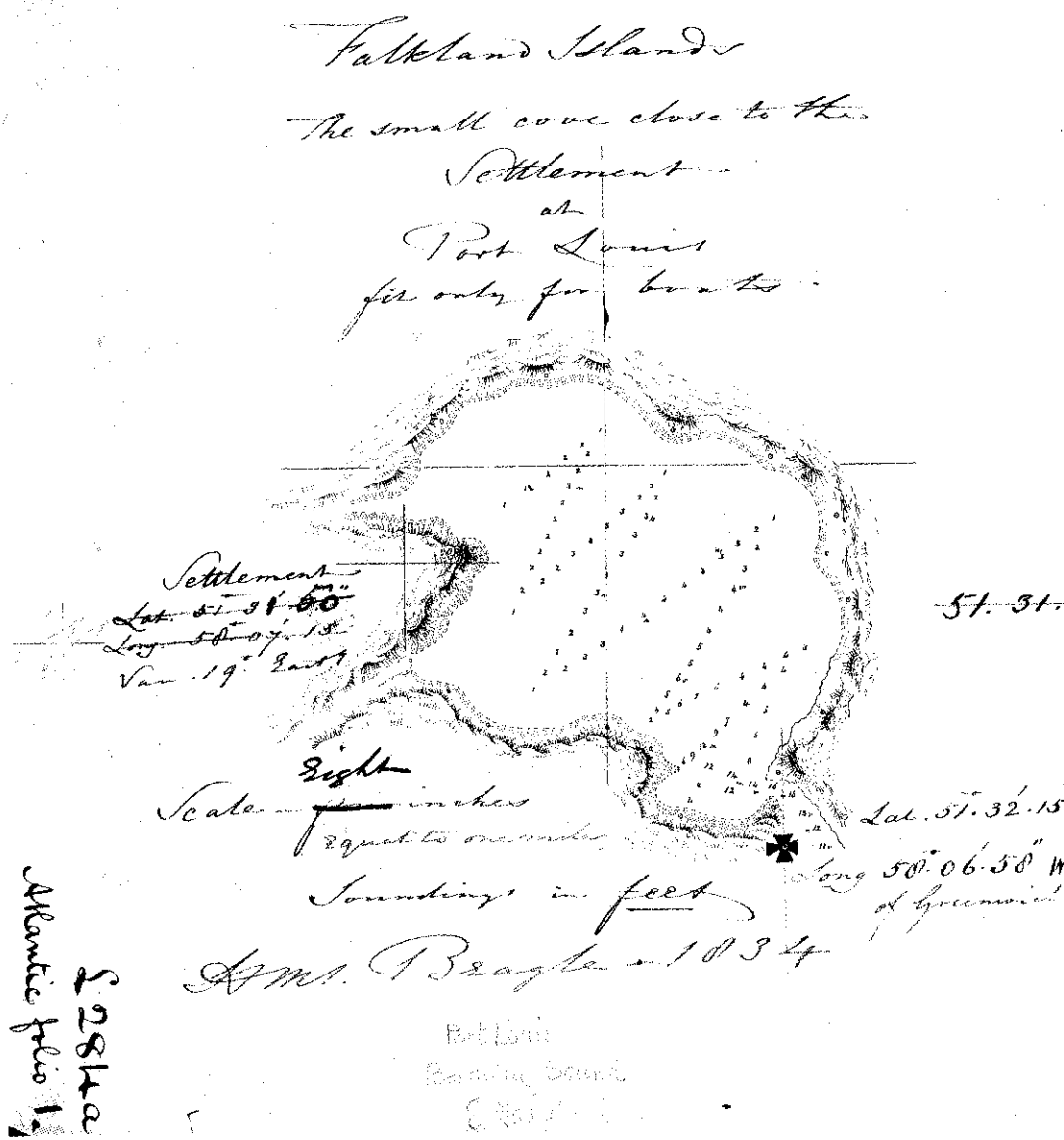


Figure 2.4. Chart of the Careenage, near Port Louis, East Falkland. Photograph: Hydrographic Office, Ministry of Defence, Taunton.

universally covered by a brown wiry grass, which grows on the peat. In this tract very few plants are found, & excepting snipes & rabbits, scarely any animals. The whole landscape from the uniformity of the brown color [sic] has an air of extreme desolation.

But Darwin (or his assistant, Syms Covington) seems to have been ready with a gun; two bird specimens are dated 3 March. It is interesting in fact to compare Syms Covington's account with that of Darwin; the servant's account seems more positive than that of his master:

While laying here we found it very squally & at times very cold – the Island in general mountainous. Not a single tree to be seen, but low Bushes with red berrys [sic] which are very good eating – here are enormous numbers of Bullocks Horses & Pigs that run wild. Rabbits, wild geese & Ducks &c & most excellent Snipe Shooting in the Marshy ground & Long grass, which the Island in general is very little else.

(*Covington Diary*: ML MSS 2009/109/632)

On 4 March Captain FitzRoy accompanied Brisbane ashore to the settlement of Port Louis (Figs 2.5 and 2.6), and was told how Vernet's formerly thriving settlement had been "ruined" during the visit of the USS *Lexington* in 1831. Captain Duncan, having taken exception to the manner in which some American whalers had been chased away from the sound, allowed his crew to do much "harm to the houses and gardens". Possibly as the result of a series of misunderstandings, Brisbane was treated . . . more like a wild beast than a human being, and . . . guarded like a felon". FitzRoy questioned Brisbane closely about the fate of the settlement:

"Where are the rest of the settlers? I see but half a dozen, of whom two are old black women: where are the gauchos who kill the cattle?"

To which Brisbane replied:

"Sir, they are all in the country. They have been alarmed by what has occurred, and they dread the appearance of a ship of war so much that they keep out of the way until they know what she is going to do."

Figure 2.5. The settlement of Port Louis, East Falkland, 1833–34, from FitzRoy's *Narrative of the Voyage*.

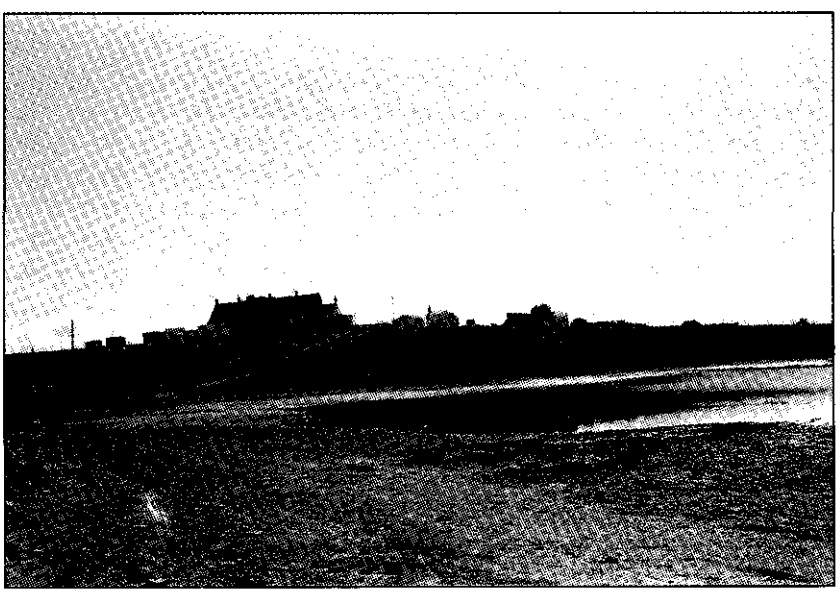


Figure 2.6. Port Louis, from almost the same point, 1989. Photograph: Patrick Armstrong.

On his return FitzRoy was shocked to find that Mr Hellyer, his clerk, and "gentlemanly and sensible young man", had been drowned. FitzRoy's account is as follows:

> He had walked about a mile along the shore of the creek near the ship, with one of the Frenchmen, who left him (having recollected that he would be wanted for a particular purpose). Mr Hellyer, anxious to shoot some ducks of a kind he had not before seen, walked on with his gun, saying he would return in half an hour. About an hour after this, the capataz of the gauchos, Jean Simon by name, riding towards the French tents to learn the news, saw clothes, a gun, and a watch, lying by the water side; but as no person was in sight, he thought they must have belonged to some one in one of the boats which were surveying, so rode on quietly; and not until another hour had elapsed, did he even casually mention to the Frenchmen what he had seen. They, of course, were instantly alarmed and hastened to the spot, with those of our party who were within reach. Some rode or ran along the shore, while others pulled in whale-boats to the fatal spot, and there, after much searching, the body was discovered under water, but so entangled in kelp that it could not be extricated without cutting away the weed. Mr Bynoe[1] was one of those who found it, and every means that he and the French surgeon could devise for restoring animation was tried in vain. A duck was found dead in the kelp not far from the body, and his gun was lying on the beach, discharged, with which the bird had been shot. . . . I also felt that the motive which urged him to strip and swim after the bird he had shot, was probably a desire to get it for my collection. Being alone and finding the water cold, he may have been alarmed, then accidentally entangling his legs in the sea-weed, lost his presence of mind, and by struggling hastily was only more confused. The rising tide must have considerably augmented his distress, and hastened the fatal result.
>
> (*Narrative*)

Darwin seems to have been in the search party – he does not seem to have ventured very far from the ship that day – for he wrote in his diary that after some clothes and a gun had been found on the shore, "We all made haste to the place & in a short time discovered the body, not many yards from the shore, but so entangled in Kelp

that it was with difficulty disengaged".

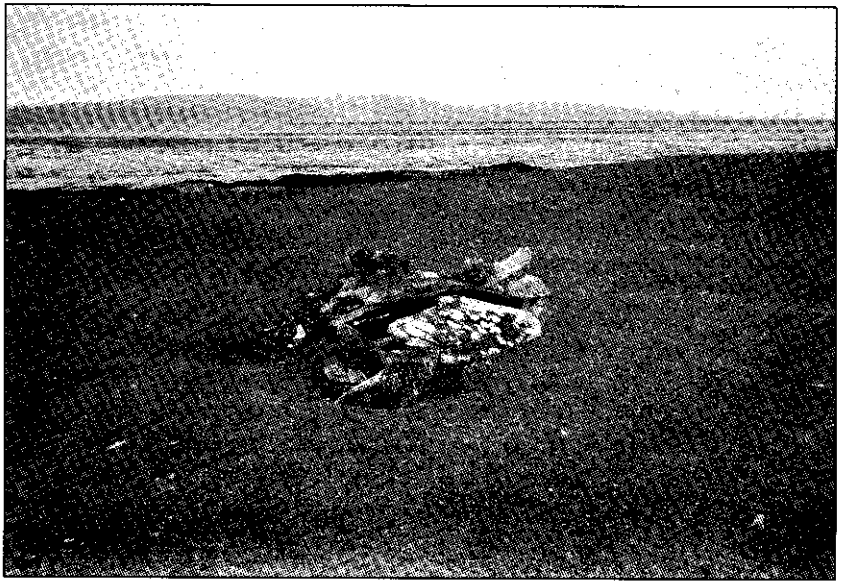
The ship's log simply notes that at 6.00pm there was "Received on board the body of Mr E H Hellyer, Clerk, accidentally drowned near the ship". At 3.00pm the following day (5 March), the interment took place. The French attended, along with almost all the officers and company of the *Beagle*, Darwin's diary describes the scene succinctily:

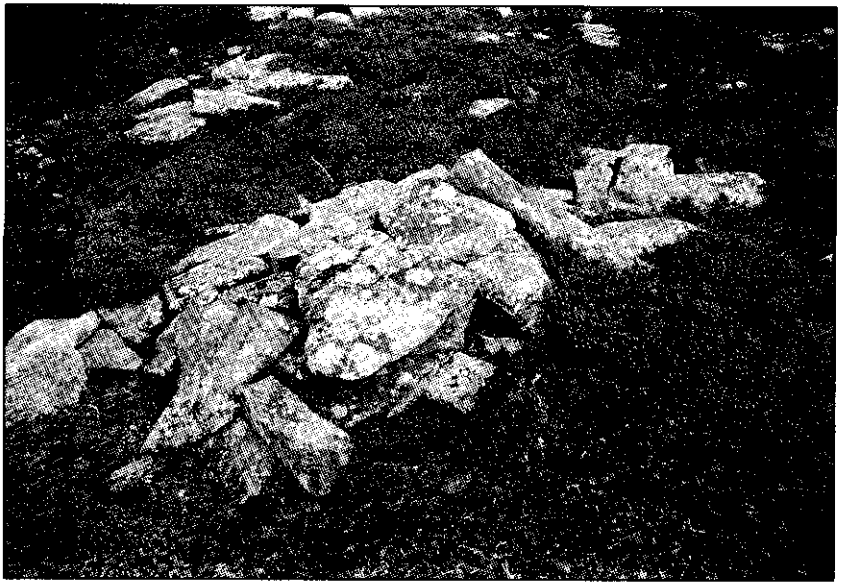
> Mr Hellyer was buried on a lonely & dreary headland. The procession was a melancholy one: in front a Union Jack half mast high was carried, & over the coffin the British ensign was thrown: the funeral, from its simplicity was the more solemn & suited all the circumstances.

The lonely headland was almost certainly Duclos Point, south of Johnson Harbour, about a mile from where the *Beagle* lay at anchor. (A point marked on some maps as Grave Point is in fact a few hundred yards to the west.) Two graves (see Figs 2.7 and 2.8), each surmounted by a cairn of large boulders and whale bones can be identified on Duclos Point: local tradition has it that one of them is that of "a French officer", but it is more probable that one of them was Lieutenant Clive (*see page* 42). Neither of the two graves bears any sort of headstone or inscription, so it is impossible to know which is the grave of Darwin's shipmate.

It must have been with a heavy heart that the ship's company of the *Beagle* went about their duties over the next few days: water had to be collected, repairs to the gig to be completed. A "great coil of hemp" – rope that had been soaked – was brought up to air on 9 March, and the log notes that "washing clothes and scrubbing hammocks" was in progress at 8.00am on the 13th. The arrival of several ships in the course of the next two or three days must have provided a smail particle of diversion. Another French whaler came in on 7 March, and two other vessels over the next couple of days, so that on 9 March Darwin was able to record:

> . . . we are now five sail in the harbour: an English schooner has agreed to carry the Frenchman & all his stores (which we could not have done) to Monte Video & to receive 20 per cent at the auction. . . . It is quite lamentable to see so many casks & pieces of wreck on every cove & corner: we know of four large ships in this one harbour. One of these was *L'Uranie*, a French





Figures 2.7. and 2.8. Two graves at Duclos Point, Johnson Harbour, possibly those of Darwin's shipmate Hellyer, and Lt Clive. Photographs: Patrick Armstrong.

discovery ship who had been round the world.

During the period 6–9 March Darwin seems to have undertaken considerable fieldwork; although the weather was generally "very cold and boisterous", he recalled:

> During three days I have been wandering about the country, breaking rocks, shooting snipe & picking up the few living productions which this island has to boast of.

From his Geological Diary and his rough notes it can be deduced that he walked around the shores of Johnson Harbour, and ventured southwards from Berkeley Sound across what is now the paddock called Top Square, and ascended the flanks of what is now named Long Island Mountain, noticing the form of the anticline, or as he called it, the "zone of upheaval" that he found there (see Fig 2.2). Specimens of rock types, plants, insects and birds were collected, geological cross-sections were drawn. Darwin's Zoological Notes suggest that sea-shore natural history occupied him on 9 March; notes written on that day describe the strips of eggs of *Doris* found along the shore (*see page* 114). A couple of bird specimens were collected on the same day (DAR 29.2/39/1–2).

The night of Sunday 10 March – Monday 11 March seems to have been particularly violent. The young naturalist's diary continues:

> In the evening it blew a tremendous gale of wind. I should never have imagined it possible for such a sea to get up in so few minutes. The Barometer had given most excellent warning that something uncommon was coming: in the middle of the day it looked like a clear; but at dinner the Captain said the glass says we have not had the worst. About an hour later it reached us in all its fury. The French Brig let go four anchors; the English schooner drove; & little more would have added another wreck.

At 10.15pm the *Beagle*'s yawl was swamped at her moorings, but by midnight she had been brought alongside. Just before 2.00am the yawl was towed to shore and emptied. Some gear and sails were lost. FitzRoy expressed the opinion that some fronds of kelp has drifted "athwart hawse" (over her mooring rope) and hindered

her riding easily on the waves.

Surveying work continued with the utmost expedition, and the crew not required for this were, as the log-book repeatedly puts it "employed variously about ship's duties": gear was stowed, watering continued, ropemakers were employed on shore, armourers worked at the forge. Darwin's note-books show that some geological work was done on Saturday 9 March, and Tuesdays 12 and 19 March, but having completed much of his initial scientific reconnaissance of the region, he seems to have occasionally been at a loss. He wrote:

> March 10th to Sunday 17th. This is one of the quietest places we have ever been to. Nearly all the ships are gone; & no one event has happened in the whole week. The boats are employed surveying.
>
> . . .
>
> Sunday 24th. We have never before stayed so long in one place & with so little for the Journal.

But even if Darwin was from time to time a little bored, with surveying and other duties to attend to, many of the officers and crew of the ship had very little time on their hands. The log once again gives us a glimpse of life aboard the *Beagle*. On Sunday 17 March, the ship's company "mustered by divisions" and divine service was performed; on 26 March at 6.00am beef and coals from the French wreck were taken on board, and at 4.00pm on the same day the sealer *Unicorn* arrived, under a "Mr William Lowe, sealing master and part-owner". William Low (FitzRoy uses the spelling "Low", describing him as "the son of a respectable Scottish land agent"; Darwin adopted that spelling later) was a useful source of information on the subject of the islands, their climate, plants, animals and people, and the young English naturalist seems to have been quite impressed by the old seafarer's personality:

> a notorious and singular man, who has frequented these seas for many years & been the terror to all small vessels. It is commonly said that Sealer, Slaver & Pirate are all of a trade: they all certainly require bold energetic men; & amongst Sealers there are frequently engagements for the best 'rookerys' [sic], & in these affrays Capt. Lowe has gained his celebrity. In their manners, habits &c. I should think these men strikingly

resembled the old Buccaneers.

The *Unicorn* impressed Captain FitzRoy and he purchased her to assist in the hydrographic survey, renaming the vessel the *Adventure*. Darwin approved:

> She is a fine vessel of 170 tuns [sic], drawing 10 feet of water and an excellent sea boat. If the Admiralty sanctions the provisioning & payment of men, this day will be an important one in the history of the *Beagle*. Perhaps it may shorten our cruize [sic]; anyhow it will double the work done; & when at sea, it is always pleasant to be sailing in company; the consort affords an object of attention to break the monotonous horizon of the ocean .

Earlier, possibly on 19 March, in search of diversion, Darwin had walked to the "town", a dignity that the "collection of half a dozen houses pitched at random" around the old stone-built French barracks,[2] scarcely warranted. He remarked that:

> In the time of the old Spaniards, when it was a Botany Bay for Buenos Ayres, it was in a much more flourishing condition . . . The inhabitants are a curious mixed race; their habitations are in a miserable condition & deficient in almost every accomodation. The place bespeaks what it has been a bone of contention between nations.

The was a certain prescience about this last remark! Darwin went on:

> The whole aspect of the Falkland Islands was changed to my eyes from that walk; I found a rock abounding with shells; & these of the most interesting geological aera.

A shetch in one of the little field note-books provides evidence that Darwin explored the area of the dome or "zone of upheaval" on the south side of Berkeley Sound (part of Long Island Mountain) after the first visit to the fossiliferous locality. However, Darwin seems to have returned on horseback to Port Louis a few days after his first visit on foot:

> For the sake of the shells I paid a visit of three days to the town. In a long ride I found the country no ways different from what it is in the neighbourhood of the ship. The same entire absence of trees & the same universal covering of brown wiry grass

growing on a peat soil.

The "shells" occur in yellow-red micaceous sandstone bands close to the settlement of Port Louis (see Fig 2.9); they may still be found in substantial numbers in exposures around the little cove or "basin" – using Darwin's notes I was able to locate his fossiliferous sites within 20 minutes. They also occur along the north shore of Johnson's Rincon (peninsula). Brachiopods of the genera *Spirifer, Australospirifer, Chonetes* and *Australocoelia (Atrypa)* occur in iron oxide-rich layers several centimetres in thickness. They are not always easy to find because the strong cleavage of the shales cuts across the bedding planes, a fact upon which Darwin commented. Specimens are most easily collected where fragments of sandstone weather out and fall away from the exposures along the shore. The Fox Bay Beds, as they are now called, are today assigned to the Devonian.[3] Many fossils were collected by Darwin from the Port Louis site and were described by John Morris and Daniel Sharpe, both Fellows of the Geological Society, in a paper in the same issue of the Society's *Proceedings* as Darwin's own paper on Falklands geology. At the time these were the southernmost Palaeozoic fossils that had been found. The picture of teeming life in ancient seas contrasted strongly with the bleak, impoverished, contemporary aspect of the Islands: the contrast was not lost on Darwin. (For further details of Darwin's geological observations see chapter 4.) Natural history collecting seems to have continued, for no fewer than 6 bird specimens are dated 25 March 1833, although the entries are not in Darwin's hand (DAR 29.2/39.15). Some geological work "near the ship" also seems to have been done that day.

The days following 26 March were spent by many of the ship's company fitting out the *Adventure* (the official log-book refers to the *Unicorn*, but wherever the name occurs, it has been lightly struck out and the new name substituted: *Adventure* was the name of the *Beagle*'s companion ship on FitzRoy's previous voyage): "Friday 29 March. Employed about the schooner [*Unicorn* del] and French wreck". Much of the material from the *Magellan* was used in adapting the little schooner as a hydrographic auxilliary.

As well as supervising this transformation, and arranging the transfer of the marooned French sailors to Buenos Aires (Covington states there were about thirty of them), FitzRoy, as

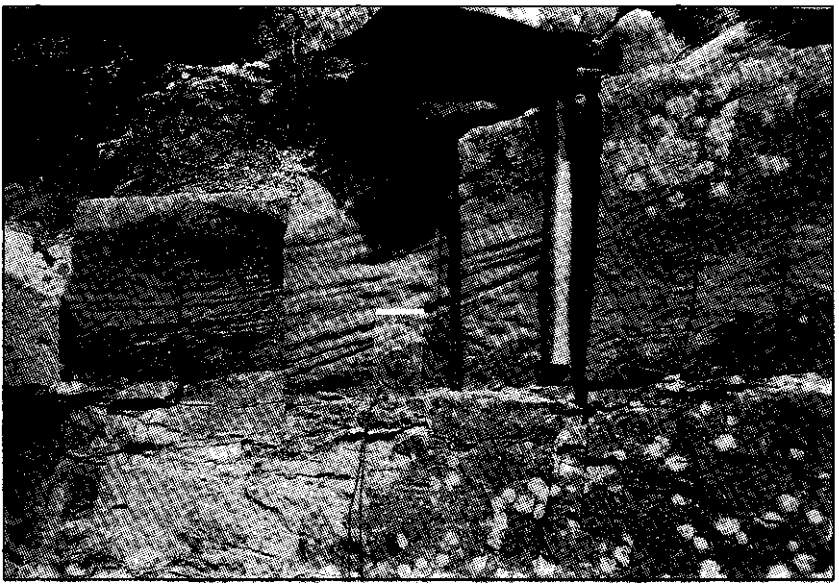


Figure 2.9. Micaceous sandstones, near Port Louis, East Falkland. Photograph: Patrick Armstrong.

the representative of British authority in the islands, attempted to maintain some sense of decorum:

> During the month we remained at Berkeley Sound, I had much trouble with the crews of whaling or small sealing vessels, as well as with the settlers, who all seemed to fancy that because the British flag was re-hoisted in the Falklands, they were at liberty to do what they pleased with Mr Vernet's private property, as well as with the wild cattle and horses. The gauchos wished to leave the place, and return to the Plata, but as they were the only useful labourers on the islands, in fact the only people on whom any dependence could be placed for a regular supply of fresh beef, I interested myself as much as possible to induce them to remain, and with partial success, for seven staid out of twelve.
>
> (*Narrative*, page 276)

It is no surprise therefore that duties kept FitzRoy close to the ship, and he was not able to explore the island to the extent that he might have wished. He expressed himself indebted to several of

the *Beagle*'s officers and to Brisbane for information included in his *Narrative*.

Darwin's final geological excursion made during the first visit to Port Louis was made on Thursday 28 March 1833. He ventured about 9 miles north of the ship – this must have been across land now known as Wether Ground to a point close to Macbride Head. He noted simply that similar "quartz rock" country continued. His watch seems to have broken upon this excursion; in his note book appears the very human reminder "send watch to be mended"!

During the first few days of April 1833, one of the ship's officers went inland "far beyond the hills seen from Port Louis" with several of the gauchos, including Jean Simon, a Frenchman, their leader or capataz. Several cattle were captured with lasso and *bora* or *bolas* or "balls", one of the bulls "bellowing in impotent rage" as he was felled making the ground tremble as he rolled over and over. Two bulls were eventually killed, skinned, jointed and the best parts of the carcasses brought back to Port Louis. The hides of these two beasts weighed seventy-three and eighty-one pounds. It will be from this cattle hunt that the 690lbs of beef recorded as being received aboad the *Beagle* on Wednesday 3 April came.

Darwin missed the excitement of this bull hunt. He was "very busy with the Zoology of the sea; treasures of the deep to a naturalist are indeed inexhaustible." Fish, shells and many types of invertebrates were collected and described in detail in the Zoological Diary.

On 4 April the *Adventure* sailed, Lieutenant Chaffers in command, and two days later the *Beagle* followed. At 8.30am on the 6th, with a force 4 south-west breeze, in fine weather but with a number of clouds breaking up the blue, late autumn sky, the ship was unmoored, weighed anchor and "made sail to 1st reef of Top sails, jib and fore top-mast stay-sail". Some adjustments were made to the sails at 10.00am in the face of a patch of squally, rainy weather. Darwin notes in his diary that the ship cruised about around the mouth of the Sound briefly to complete the survey, but noon saw the little vessel "standing out of the Sound" and at 1.00pm she altered course to the north-west en route for the Rio Negro.

In departing, the *Beagle* left the settlement replete with discontent.

FitzRoy recalled his feelings:

> When idling at the settlement they [the gauchos] gamble, quarrel and fight with long knives, giving each other severe wounds. With their loose ponchos, slouched hats, long hair, dark complexions, and Indian eyes, they are characters fitter for the pencil of an artist than for the quiet hearth of an industrious settler. Besides these gauchos, we saw five Indians, who had been taken by the Buenos Ayrean troops, or their allies, and allowed to leave prison on condition of going with Mr. Vernet to the Falklands. Including the crews of some thirty whale-ships, hovering about or at anchor among the islands; the men of the American vessels, all armed with rifles; the English sealers with their clubs, if not also provided with rifles; these cut-throat looking gauchos; the several French whalers – who could not or would not see why they had not as good a right to the islands as Englishmen – there was no lack of the elements of discord; and it was with a heavy heart and gloomy forebodings that I looked forward to the months which might elapse without the presence of a man-o-war, or the semblance of any regular authority.
>
> (*Narrative*: 278–279)

Port Louis and the head of Berkeley Sound in 1989. Photograph: Patrick Armstrong

Chapter 3

The Chronology of Charles Darwin's visits to the Falkland Islands
(2) The Second Visit

It was almost exactly eleven months later that HMS *Beagle* returned to the Falklands. At Noon on 9 March 1834 Beauchêne Island (see Fig 1.2) was sighted 8 or 9 miles to the north. In the early morning of the day following, the ship being blown before a force 6 or 7 gale, the mainland of East Falkland was seen to the north-west; Cape Pembroke was rounded around 8.00am. During the early afternoon she "tacked as requisite up Berkeley Sound", the *Beagle* then anchoring close to her former place in Johnson Harbour.

If the captain and crew of the the ship received a few surprises when they first visited Port Louis, these were as nothing to the "complicated scenes of cold-blooded murder, robbery, plunder, suffering . . . [and] infamous conduct" described to them by Lieutenant Smith, who was by then acting as Governor, when he went on board at 2.30 that afternoon. Darwin's diary continues:

> With poor Brisbane, four others were butchered; the principal murderer, Antuco, has given himself up; he says he knows he shall be hanged but he wishes some of the Englishmen who were implicated, to suffer with him; pure thirst for blood seems to have incited him to this latter act. Surrounded as Mr Smith is with a set of villains, he appears to be getting on with all his schemes admirably well. –

Other sources suggest that Darwin was not entirely accurate on a few details; the prisoner's name was Antonio Rivero, and catching him seems to been anything but easy, even if he did, eventually, surrender.

The facts of the incident seem to be as follows.[1] About four months after the *Beagle*'s previous visit, on 26 August 1833, immediately after William Low had left on a sealing expedition, a

group of three gauchos and five "Indians" murdered Brisbane, Dickson (the Irishman in charge of Vernet's store and the person left in charge of the flag left by Captain Onslow, *see page* 20), Jean (Juan) Simon (the capataz of the gauchos) and two others. Antonio Rivero called on Brisbane, then living with Low, and asked for money. He then knifed him (or according to some sources, shot him).[2] Simon put up a fight, but the others, "overcome by fear, fell easy victims". Brisbane's body was then pulled by a horse some distance, stripped, and mutilated. The terrified remainder of the settlers (13 men, 3 women, 2 children), after remaining two days with the murderers, escaped to Hog Island, a small island in the Sound and lived on fish and birds' eggs until the arrival of the English sealer *Hopeful*, on which there was a Royal Navy officer, a Mr Rea. Rea did his best to assist the settlers but could not remain long. A month later HMS *Challenger*, under Captain M Seymore, arrived. After the elapse of some time and a good deal of chasing around East Falkland, Lieutenant Smith, brought by the *Challenger* as acting Governor, with a small party of marines, managed to capture most of the desperadoes; they were eventually transported to England, but because of legal difficulties involving uncertainty about under which jurisdiction they should be tried, and Britain's unwillingness to acknowledge Argentina's authority in a Falklands matter, they were never convicted.

Shortly before the *Beagle* appeared on the scene, Lieutenant Smith and his squad of marines managed to capture Antonio Rivero, the ringleader, confining him to an islet. On the arrival of the *Beagle*, FitzRoy had him put in irons (the log records: Tuesday 18 March – Received on board Antonis Rivers, Prisoner). Two others, Jose Maria Luna, who "turned King's evidence" and an Englishman named Channon, who was apparently less implicated in the murders, were also received on board, but under less austere conditions.

William Low, meanwhile, on his return from sealing, had found that the villains, then still at large, were out for his blood. Feeling that he could do nothing on foot against the mounted, armed gauchos, he fled, eventually falling in with the *Adventure*, where Lieutenant Wickham, who was by then in charge of that vessel, employed him as a pilot, finding his local knowledge invaluable.

But to return to the details of the *Beagle*'s second visit to the

Falklands. After she had taken Lieutenant Smith on board, she shortened sail, and came to in 6 fathoms, mooring with stream anchor at 3.30pm. Sails were furled and top gallant yards were lowered.

By 6.00am the following morning (11 March 1834) the gig was out, and work in hand refitting the *Beagle*'s rigging. No doubt preparations were also being made for the continuation of the hydrographic survey.

Perhaps in order to be closer to the source of lawful authority, such as it was, in Lieutenant Smith, at the settlement, and perhaps also to make it easier to pick up prisoners, early on Wednesday 12 March FitzRoy took his ship out of Johnson Harbour, anchoring close to Port Louis itself "in 4½, fathoms, with small bowyer". 260lb of beef were taken aboard.

On the afternoon of 13 March two vessels came into the lonely Sound within half an hour of each other; one was a London sealing cutter, the *Susanna Ann*, which left again the following day, the other was the *Adventure*. The *Adventure* had had an "exceedingly prosperous" voyage. Darwin commented that they had "killed so many wild bulls, geese, &c. &c, & caught so many fish that they have not tasted salt meat". This, along with fine weather was "beau ideal of a sailor's cruize"! Survey work, with Low as pilot had gone extremely well.

Darwin continued his fieldwork, commenced the previous autumn. The first page of his 1834 Falklands note-book shows Darwin writing comments on the introduced rabbit (some authorities described *Lepus magellanicus* as a separate species, but Darwin doubted this) and birds such as the jackass penguin (Fig 3.1) and vulture. Collection seems to have started at once for several bird specimens were taken on 11 and 14 March. More specimens of rocks, plants, fish, shells and other invertebates were collected, and many further observations made. He re-studied the exposures around Johnson Harbour, and re-examined the tilted and folded strata of Long Island Mountain, on the south side of the Sound. He seems to have explored this area rather further to the south than on his 1833 excursion, and made a careful study of the enormous stone-run now called Prince's Street. This elongate, almost glacier-like mass of rocks that vary in size from that of a man's head to that of a London bus, runs for about four miles between Long Island Mountain and Mt Vernet. Darwin expres-

Figure 3.1. Jackass penguins, East Falklands. Photograph Patrick Armstrong.

sively called this valley "The valley of the fragments". He seems to have clambered across the several hundred yards' width of Prince's Street ("stones as big as churches"), noticing the tinkling stream far underneath the piled up boulders. The stream was still "tinkling" in 1989. He apparently experienced poor weather there, as elsewhere during his visits to the Falklands:

> . . . being overtaken by a shower of rain we easily found shelter beneath one of these huge fragments. –
>
> (DAR 204)

The "we" suggests that Covington accompanied him.

The weather was not good during the period 11–14 March. Darwin wrote:

> I went on shore, intending to start on a riding excursion round the island, but the weather was so bad I deferred it."

Dealing with the prisoners, supervising the surveying, and liasing with the *Adventure*, gave FitzRoy little more time to explore than he had had in 1833, but he did have time to visit the settlement. Already depressed by what he had seen and heard of violence,

pillage and murder, what he found there must have sickened him:

> When I visited the settlement it looked more melancholy than ever; at two hundred yards' distance from the house in which he had lived, I found to my horror, the feet of poor Brisbane protruding above the ground. So shallow was the grave that dogs had disturbed his mortal remains, and had fed upon the corpse. This was the fate of an honest, industrious and most faithful man: of a man who feared no danger and despised hardships. He was murdered by villains, because he defended the property of his friend: he was mangled by them to satisfy their hellish spite: dragged by a lasso, at a horse's heels, away from the houses, and left to be eaten by dogs.

It may safely be assumed that FitzRoy saw to it that Brisbane's grave was put in neat order.[3]

This was not the last disagreeable task that the crew of the *Beagle* had to tackle before leaving the islands. While the ship was preparing to put to sea, the body of Lieutenant Clive, late of HMS *Challenger* was found lying at high water in a little frequented part of the Sound. Lieutenant Clive had been accidentally drowned when a small boat overturned some three months previously.[4] Notwithstanding the cool waters of Berkeley Sound, the state of the body must have been unspeakable. The following morning, it was recalled by FitzRoy, "I buried it in a grave on shore, not far from the tomb of our regretted shipmate Hellyer" (see Figs 2.7 and 2.8). A little surprisingly Darwin's diary is silent on the burial of Lieutenant Clive. But the Lieutenant was not a member of the *Beagle*'s complement, and seems to have been known to no-one on board; his body does not appear to have been brought to the ship (the log simply reports "Found the body of Lieut Clive", not "Received on board. . . "). And the disposal of a partly decomposed body must have been very unpleasant work indeed. The interment took place very early in the morning of 7 April, the log stating "Captain and Officers went on shore & interred the body of Lieut Clive, late of HMS Challenger". It rather looks as though not many of the crew of the ship *Beagle* were expected to attend.

Darwin, frustrated by bad weather earlier, set out on his ride to the south and west, early in the morning of Sunday 16 March. He had hired six horses, and obtained the services of two gauchos. It is not clear whether Darwin's servant Syms Covington accom-

panied him, but this is quite likely. For some reason Darwin seldom mentions the presence of Covington in his notes or Diary although he was quite often present on Darwin's inland excursions. Alas, Covington's own diary gives no clue: his entire entry for the second visit comprises only thirteen and a half lines, and includes little but a slightly garbled version of the murder and the finding of Lieutenant Clive's body.[4]

Charles Darwin described his gaucho companions in the following terms:

> These two were the only two Spaniards who were not directly concerned with the murder; but I am afraid my friends had a very good idea of what was going to take place. However, they had no temptation to murder me & turned out to be most excellent Gauchos. That is, they were dextrous hands in all the requisites of making the camp-life comfortable.

To begin with, although the weather was "very boisterous and cold with heavy hailstones", progress was good. Charles' descriptions in his diary of the country echo accounts he had given before:

> . . . nothing could be less interesting. The country is uniformly the same; an undulating moorland; the surface covered with light brown withered grass, & some few low shrubs growing out of an elastic peaty soil. . . Few sorts of birds inhabit this is miserable looking country: there are many flocks of wild geese feeding in the valleys, & solitary snipes are common in all parts.

The exception in this, to Darwin, uninspiring panorama (Fig 3.2), was "some little geology". The rough note-books show that he made many observations on the rocks on this journey – their types, angles and directions of dip, strike, cleavage and so on, and Darwin must often have stopped to take notes, examine exposures and collect specimens. The geological hammer, now preserved at Down House in Kent, must have been in frequent use.

Darwin also saw a single troop of wild horses to the north of the hills; he commented that these animals always remained in the east of the islands. Neither he nor the gauchos were able to offer any explanation.

The route followed by Darwin and his companions on 16 March 1834 can be worked out with a fair degree of certainty (see Figs 2.2, 3.3, 3.4, 3.5). They must have started from Port Louis, for

Figure 3.2. "The country is uniformly the same; an undulating moorland, the surface covered with light brown grass . . . growing out of a peaty soil." Photograph: Patrick Armstrong.

the *Beagle* was moored nearby, and it must have been from the settlement that the gaucho companions were recruited and the horses were hired. From there the riders would have been able to "get on pretty well" as Darwin put it, over the low col of Green Hill, proceeding almost directly south. To the west were the tributary inlets of Port Salvador, to the east the rock-strewn uplands of Long Island Mountain. Darwin had on at least two previous occasions explored this upland on foot, and to do so again would have been pointless, put an unnecessary strain on the horses, and slowed progress enormously. Also the massive obstacle of Prince's Street would have been quite impossible for horses to cross.

From Green Hill, the party would have traversed the narrow strip of lowland between the unnamed inlet north of Stud Rincon, and the screes and stone runs around the western end of Prince's Street, and from there ridden across open country towards the south, close to what is now the settlement of Estancia (Spanish for "farm"). There is evidence from FitzRoy's account that there was some farming enterprise in existence in 1834 at this point, or at least that the cattle frequently grazed on the rather better land

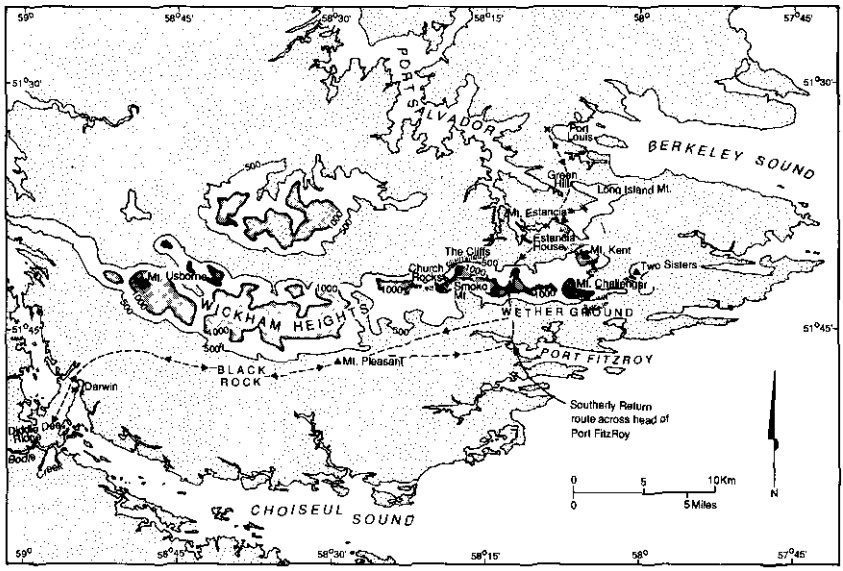


Figure 3.3. Approximate overland route of Darwin and his companions, March 1834.

hereabouts – the name in any case implies a Spanish or Argentinian (Darwin and FitzRoy used the term "Buenos Ayrean") rather than a British or French origin, and thus an establishment before about 1832. This being the case one can suppose that some form of crude track existed.

There are several possible routes that Darwin and his companions might have taken across the "main range", the principal east–west mountain barrier across East Falkland (Fig 3.4), and it is difficult to be absolutely certain which was followed. Some routes, however are intrinsically less likely than others. Almost the only clue given in Charles' diary is the entry:

> There is one main range of quartz rock hills, whose broken barren crests gave us some trouble to cross.

That the quartzite ridge "gave trouble" is unsurprising. Gradients in many parts are extremely steep, partly as the result of the angles of dip of the rocks being very high. In places on the crest, when the observer looks along the ridge, parallel to the "strike", the impression is of a series of near-vertical plates (compare Fig 4.7). Second, the upland, particularly in the Mount Kent area, is much dissected and broken; it is cut into by a number of relatively

short, but steep-sided valleys that in many cases join one another at right angles. Third, many of these valleys are floored by, and the their sides covered with, massive stone-runs – elongate jumbled piles of irregularly shaped boulders that are virtually impossible for horses to cross. A final difficulty is posed by the fact that thick layers of peat, areas of swamp and lakes abound: all these may pose difficulties for horses.

The possible routes (Fig 3.4) would appear to be:

1. To the north and east of Mount Kent, and then southwards along the valley west of two rocky pinnacles known as the Two Sisters, and then skirting Wall Mountain, westwards, threading a way through a group of several dozen small lakes and a series of stone-runs on Wether Ground, on the southern slopes of Mount Challenger. This is a complex route, and involves a major detour to the east. There are numerous places where the going is extremely difficult: it is just passable in a modern Land Rover.

2. The Smoko Rocks route. This is the most direct passage through the mountains, and is followed in places by a track today. As the crest of the ridge near Smoko Mountain and Smoko Rocks is visible from Estancia House, and the approximate outline of the route can be seen from afar, it would be easier to navigate in the absence of maps. It does however involve some *very* steep climbing up the northern side of the ridge, and there are a number of stone-runs.

3. Just east of "The Cliffs". There is a good pass a little over 4km (about 2 miles) west of the Smoko Rocks route. Gradients are steep, but relatively even, and, on the northern side of the range, horses would find their progress less impeded by stone-runs than on either of the previous routes. There is an excellent prospect to the south from the col, particularly in the early afternoon when the weather is fine. Unfortunately, there is every indication that the weather was poor, but providing visibility was not too impeded by rain and cloud, the view down the long straight unnamed valley trending south–east from The Cliffs would enable the horsemen to pick out their route carefully. A route along the north-eastern side of the valley is probably precluded by the superabundance of screes and stone-runs, but a route along the south-western side of the valley is probably possible on horseback today.

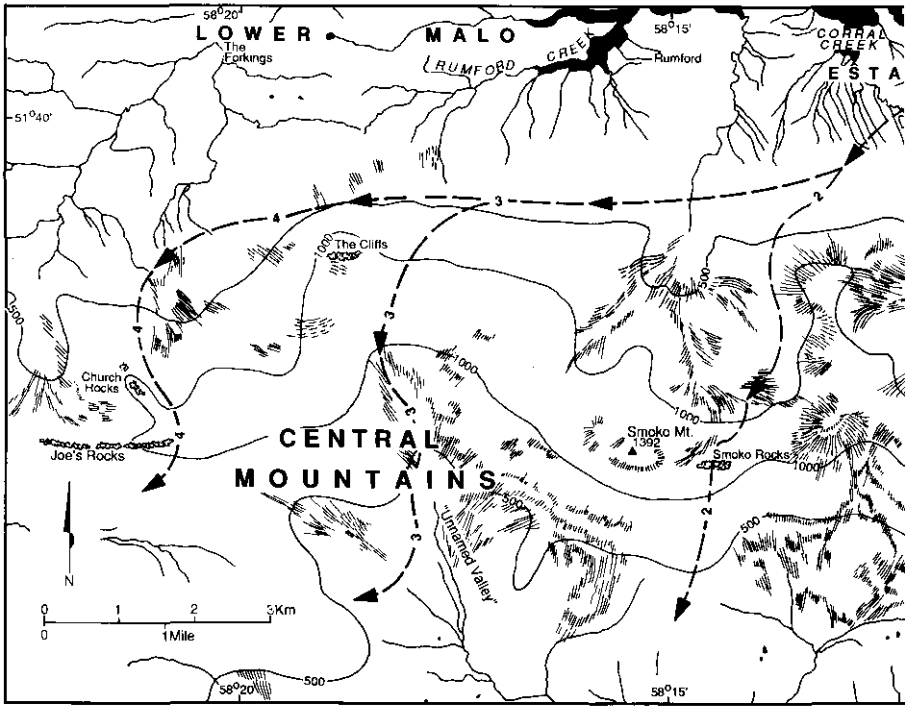
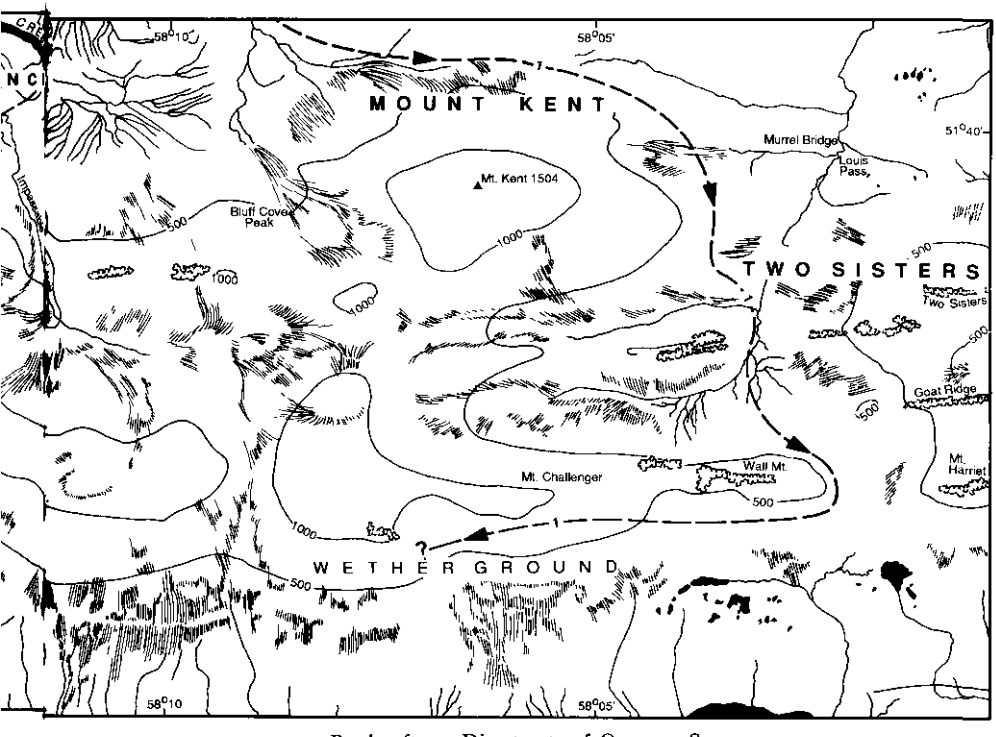


Figure 3.4. Possible routes through the main Range.

4. The Church Rocks route. A re-entrant thrusts deep into the Main Range just west of Church Rocks, about 5km beyond The Cliffs. There are stone-runs, but a route might be found across the divide near Church Rocks themselves or an elongate wall of quartzite known as Joe's Rocks. From the crest a route might be found to lower ground joining the "long valley" mentioned in connection with Route 3.

Route one presents major difficulties, and also because it involves a time-consuming major detour away from Darwin's destination, I therefore consider it unlikely. Similarly the Church Rocks route (number four) involves a substantial detour to the west: it would be natural to wish to cross the ridge as soon as possible, and to skirt the northern fringes of the Main Range for 15km before crossing would seem to me to be an unlikely course of action.

There is one further piece of circumstantial evidence that pro-



Partly after a Directorate of Overseas Survey map.

vides an indication that either the Smoko Rocks or The Cliffs (number 2 or 3) was used. This will be mentioned when the return journey is discussed.

Once across the divide it can safely be assumed that Darwin and his gaucho companions skirted the southern foothills of the mountains on their way westwards, making reasonably good progress over the open, undulating country. The most exciting event of the first day's ride was undoubtedly the bringing down of a cow with the "bolas" or "balls", by one of the gauchos – St Jago by name. Darwin's account of the incident is worth quoting in full.

> On the South side of the range of hills we came into the best country for wild cattle; we did not however see very many, because the Murderers had by hunting them so much, driven them amongst the mountains. These men only killed the cows, & then took out the tongue & piece of meat from the breast,

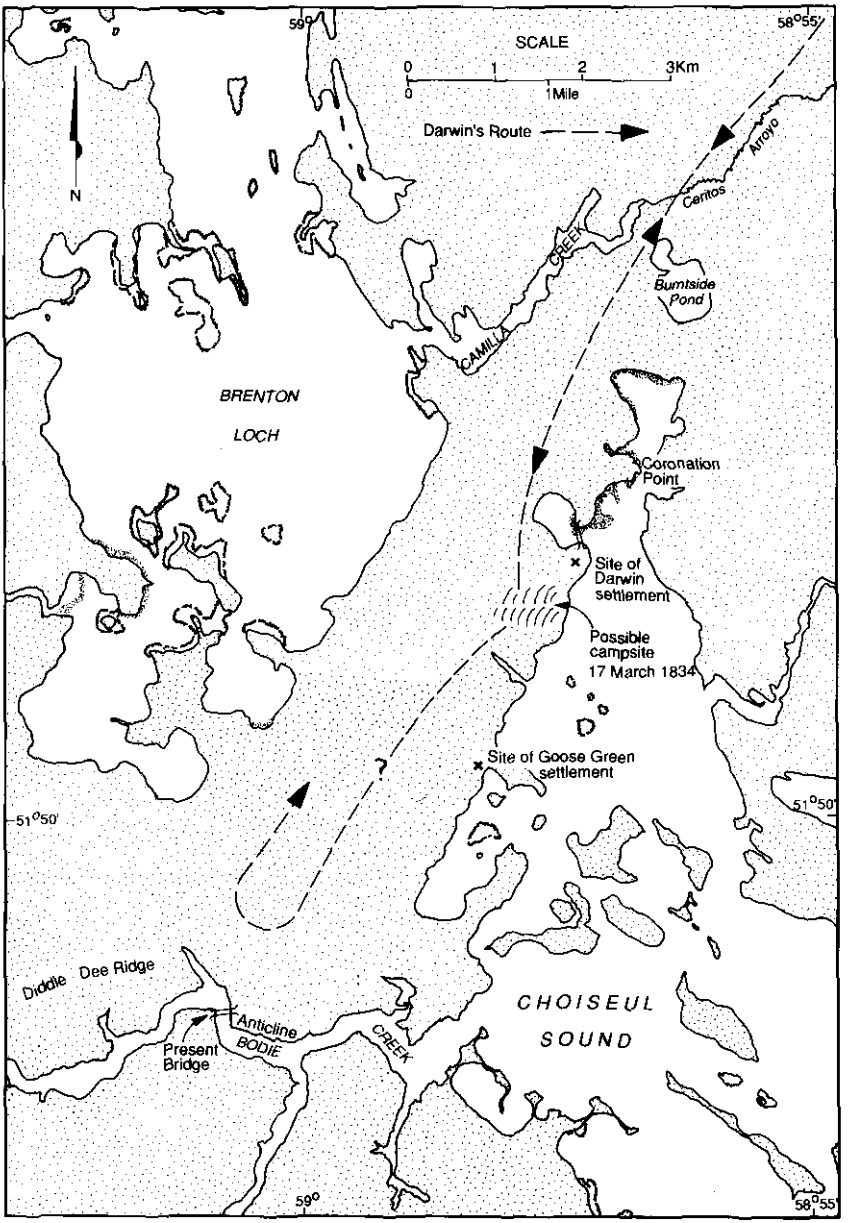


Figure 3.5. Darwin's route, 17 – 18 March 1834.

when this was finished they killed another. By their own account they must have killed more than 200 head. We saw plenty of half decayed carcasses In the evening we came across a nice little herd. St Jago soon separated a cow, threw his balls, they hit her legs, but did not entangle her: he dropped his hat to mark the place where the balls fell, uncoiled his lazo & again we commenced the chase; at last he caught her round the horns. The other Gaucho had gone on with the horses, so that St Jago had some difficulty in killing the furious beast. The horses generally soon learn for their own safety to keep the lazo tight when their rider dismounts, when this is the case the man can easily hamstring & thus secure the beast. Here the horse would not stand still, & it was admirable to see with what dexterity St Jago dodged about the cow till he contrived to give the fatal touch to the main tendon of the hind leg. After driving his knife into the head of the spinal marrow the animal dropped as if struck by lightning. St Jago cut off enough flesh with the skin, & without any bones, to last for our expedition. We then rode on to our sleeping place. Meat roasted with its skin ('carne con cuero') is known over all these parts of S. America for its excellence. It bears the same relation to common beef, which venison does to mutton. I am sure if any worthy alderman was once to taste it; 'carne con cuero' would soon be celebrated in London.

Darwin was anything but a distant spectator to this incident. He later wrote:

> St. Jago had some difficulty in killing the furious beast. He managed to get her on a level piece of ground, by taking advantage of her as often as she rushed at him; and when she would not move, my horse, from having been trained, would canter up, and with his chest give her a violent push.
>
> (*Voyage*, p180)

It is also worth recalling that naturalist Darwin stopped to inspect some of the "half decayed carcasses" mentioned in the Diary extract for beetle specimens (*see page* 14).

The day's ride seems to have been a long one (at the equinox there would have been 12 hours of daylight). However, bearing in mind the fact that: the horses were travelling away from home,

that the route "gave them some trouble", and in places was steeply uphill, that the weather was despicable, and that the cattle-hunt, geological investigations and specimen collecting would have taken some time, a journey of more than about 40km (25 miles) would seem unlikely. This would take the riders to somewhere in the rather featureless undulating country of the Black Rock or Mount Pleasant area, south of Wickham Heights. It is possible that Darwin and his friendly "Buenos Ayrean" gauchos slept close to the present site of the massive British Military Base, Mount Pleasant Airport.

Darwin evidently enjoyed his supper of "carne con cuero"; indeed throughout his time in South America, he enjoyed camping with the gauchos. He wrote of a night a few months previously, in Patagonia:

> This was the first night which I passed under the open sky, with the gear of the recado [saddle] for my bed. There is high enjoyment in the independence of gaucho life – to be able at any moment to pull up your horse and say, "Here we will pass the night." The death-like stillness of the plain, the dogs keeping watch, the gipsy-group of Gauchos making their beds round the fire, have left in my mind a strongly-marked picture of this first night, which will never be forgotten.

Darwin noted, however that "during the night it rained", and the next day (Monday 17 March 1834) the weather continued poor; it "was very stormy with much hail & snow". The riders continued towards the west. Cattle seem to have been more numerous, but because of the recent slaughter of many cows, bulls were in the majority. They impressed Darwin and provided some further excitement:

> These [bulls] wander about by twos & threes or by themselves & are very savage. I never saw such magnificent beasts; they truly resemble the ancient sculptures, in which the vast neck & head is but seldom seen amongst tame animals. The young bulls run away for a short distance, but the old ones will not stir a step excepting to rush at man & horse; & many horses have thus been killed. One old bull crossed a boggy stream & took up his stand on the side opposite to us. We in vain tried to drive him away & failing we were obliged to make a large circuit. The

> Gauchos in revenge were determined to render him for the future innocuous: it was very interesting to see how art completely mastered huge force. One lazo was thrown over his horns as he rushed at the horse, & another round his hind legs: in a minute the monster was stretched harmless on the ground. (*Diary*)

It is interesting to see how the well-bred Englishman varies in the degree of delicacy with which he refers to the castration of the bull. In his rough field note-book there is a blunt annotation "geld bull"; in the Diary, which he perhaps envisaged being read by others (including his sisters) the gauchos "render him for the future innocuous". In *The Voyage of the Beagle*, this phrase, perhaps because it might not be absolutely clear, becomes, as a compromise "emasculate him and render him for the future harmless".

Darwin the naturalist was busy observing everything about him. In his note-books he wrote: "no wild horse here, only cattle". Other jottings give an indication of what he noticed, and also perhaps, reflect snatches of conversation with his gaucho companions: "snipe & geese"; "Hawk's nest"; "yellow legged hawks – females" (striated caracara, *Phalcaboenus australis* or cinerous harrier *Circus cinereus*, perhaps); "foxes have holes, generally silent excepting when in pairs"; "hawks remain tame whole year"; "where there are black rabbits there are others"; "horses very expensive, 100ps each"; "sandstones generally more-or-less slaty running NW by W". Darwin, as always, observes the landscape as a whole, as well as the little details:

> Very many valleys parallel to the range & like furrows in the sea.

After following the foothills of the range, with the vast grey bulk of Mt Usborne glowering on their right, the riders struck south, across an area of lowland, along a creek called Ceritos Arroyo, through a very narrow stretch of land separating Burnside Pool from Camilla Creek (the alternative, to the east of the pool, is a damper route, and is perhaps less likely). See Fig 3.5.

Darwin explicitly states that they slept the night of the 17 March in a valley in the neck of land which joins the Rincon del Toro (the "Bull Peninsula", forming the south-west of the island, now known as Lafonia) to the remainder of East Falkland. The valley was

pretty well sheltered from the cold wind, but there was very little brushwood for making a fire.

The isthmus is now the site of the twin settlements of Darwin and Goose Green, between the inlets of Choiseul (pronounced "chisel") Sound and Brenton Loch. The establishment of the exact site of the camping place is difficult. There are in fact about three possible valleys facing Darwin Harbour and Choiseul Sound, between Coronation Point and the present site of the Goose Green settlement. Perhaps the most likely is a narrow, steep-sided dry valley about 0.8km (about half a mile) south of the Darwin settlement (Fig 3.5). This is sheltered, and today at least, contains almost no brushwood, although of course any shrubs that grew there in Darwin's day could long since have been cleared. (The valley is just a stone's throw from the locale of the main fighting in the Battle of Goose Green, 27–28 May 1982, and close to the place where Colonel H Jones, VC, fell.)

Whichever valley it was, it obviously made a good camping-place, and the camp-craft of the gauchos held further surprises for the young Englishman; the rough note-book simply reports enigmatically: "Bones burn".

But in his Diary Darwin records:

> The . . . Gauchos soon found what to my surprise made nearly as hot a fire as coals. It was the bones of a bullock, lately killed but with all the flesh picked off by the Vultures. They told me that in winter time they have often killed an animal, cleaned the flesh from the bones with their knives, & then with these very bones roasted the meat for their dinner. What curious resources will necessity put men to discover.

We can safely assume, that as the previous day the St Jago had removed from the carcass enough meat "to last for our expedition", that "carne con cuero" again appeared on the menu. Darwin's account in *The Voyage of the Beagle* adds a few culinary details to the bare facts recorded in the Diary:

> A large circular piece [of meat] taken from the back is roasted on the embers with the hide downwards and in the form of a saucer, so that none of the gravy is lost.

Covington noted in his diary, on one occasion, that they used the

tea plant and wild thyme to make tea while on the Falklands;[5] perhaps the meat and gravy were washed down with an aromatic brew made from one of these plants.

Just how far south did Darwin explore? He does not say, but it is reasonable to presume that he would proceed beyond the narrow confines of the isthmus to explore what lay beyond it if this were possible. The note-book reference to whole series of ridges and valleys "like furrows in the sea" might well apply to the undulating country of Lafonia.

However about 4km (under 3 miles) south of Goose Green the way south is obstructed by a quite deep, wide inlet, Bodie Creek. It is unfordable except by going many miles upstream to the west. It was not bridged until the Falkland Island Company constructed a suspension bridge over it in 1925. It is therefore highly unlikely that Darwin went any further to the south. Further negative evidence exists in that on the north shore of the creek, *but only clearly visible from the south side* is an magnificent exposure of bedded sedimentary rocks folded into a sharp upfold. Knowing Darwin's interest in structural geology and tectonics (see chapter 4) it is almost certain that had he seen it, he would comment on such a feature, and perhaps sketch it in his notes. No such description or sketch occurs. Possibly Darwin's party rode the the short distance (about 8km, 5 miles) south of the camp-site to somewhere near Diddle Dee Ridge, wherefrom they could view Bodie Creek and the landscape of Lafonia, and assure themselves that continuing south would be difficult.

The bad weather continued on Tuesday 18 March 1834. "It rained nearly the whole day" wrote Darwin, "so that at night it began to be very miserable work". Geological observations, however, were maintained, and despite the difficulties and discomforts, a few cryptic scribbles about the type of rocks, angles and directions of dips and crude sketches continue to appear in the "little note-book".

Darwin grumbled that there was not a dry spot upon which to sit after the day's work. However he was surprised to find that the lack of dry wood posed no difficulties for the gauchos when they commenced to light a fire.

> The best wood in the island for burning is about the size of a large heath, it has however the good property of burning when

green. It was surprising to see the Gauchos in the midst of rain & everything soaking wet, with nothing more than a tinder box & piece of rag, immediately make a fire. They seek beneath the bushes for some dry twigs or grass & this they rub into fibres & then (somewhat like a bird's nest) surround it with coarser twigs; they put a rag with a spark of fire in the centre & then covering it up with fibrous matter, hold it up to the wind. When by degrees it smokes more & at last burst out into flames. I am sure no other method would have any chance of succeeding with such damp materials.

The shrub referred to hear is almost certainly diddle dee (*Empetrum rubrum*), a plant about a metre in height, common throughout the Falkland Islands, that fits Darwin's description well, even to the extent that the central portion of the plant sometimes dies away, leaving a mass of dry, dead twigs.[6]

They seem to have slept under their large, elaborate saddles:

We managed with our Recado's [sic] to keep pretty warm and dry; but the ground on which we slept every night more or less a bog.

It is likely that the party camped approximately equidistant between the Darwin-Goose Green isthmus and Port Louis, probably not all that far from their campsite on the outward trip. However, if they had rested in exactly the same spot, some comment would surely have been made. The note "At sleeping place, coarse slate D[ipping?] SSW" will not allow the site to be located exactly, but is compatible with a point on the southern plain somewhere south of Wickham Heights.

Some very human feelings are expressed in this passage:

Each morning, from not having ridden for some time previously, I was very stiff. I was surprised to hear the Gauchos, who have from infancy lived on horseback, say that under similar circumstances, they always suffer.

(*Voyage*)

Darwin's account of the next day (Wednesday) begins in very much the same manner as his diary entries for the preceding few days:

19th. The weather continued so bad I was determined to make a push & try to reach the Ship before dark, which I succeeded in

doing. From the great quantity of rain this boggy country was in a very bad state. I suppose my horse fell at least a dozen times & sometimes the whole six were floundering in the mud together. All the little streams have their sides soft, so that it is a great exertion for the horses to jump over them, & from the same cause they repeatedly fall.

The word "caracara" appears here and there in the note-book, and may imply that the sight of a "johnny rook" (*Phalcoboenus australis*, a bird of prey noted for its tameness and inquisitive nature) may have enlivened the dreary, wet, return ride, but little else of interest was noted. Darwin's Diary goes on:

To finish our misery, we crossed an arm of the sea which was up to the top of the horses back, & little waves from violent winds broke over us.

This inlet, in all probability, was that of Port FitzRoy – the group seem to have taken a slightly more southerly route along the lowlands than on the outward ride (Fig 3.3). Indeed, in his account in one manuscript (DAR 33/165), Darwin states ". . . I crossed from Berkeley Sound to Choiseul Bay and returned by a longer circuit." They then found themselves cut off, and rather than double back, they forded the inlet, possibly somewhere near the present site of FitzRoy Bridge. From here it is about 5km (under 3 miles) in a direct line northwards to the Smoko Rocks col. The Church Rocks route, and even The Cliffs route, would be less obvious crossings from this point. Darwin does not mention crossing the uplands by a different route from the one he followed on the 16th. It therefore seems most likely that, both on the outward and return rides, the group crossed the Main Range between Smoko Rocks and Smoko Mountain. My discussions with those who know the uplands today confirm this impression.

In view of the weather experienced throughout much of the four-day excursion, it is unsurprising that Darwin ends his account of the trip with the remark:

Even the Gauchos were not sorry to reach the houses.

Darwin's experience of the weather seems to have been particularly unfortunate. Although rain and cloud can be appreciable in any month, large amounts of snow and hail are unusual in the

lowlands in mid-March. Winds are generally strong, but changeability is the keynote of Falklands climate. Sometimes in March long spells of sunny weather can occur. Partly as the result of discussion and correspondence with Sulivan, he later admitted that his own experiences might not be quite typical, for in the 1845 and subsequent editions of the *Voyage of the Beagle* he added a *footnote:*

> From accounts published since our voyage, and more especially from several interesting letters from Capt. Sulivan, R.N., employed in the survey, it appears that we took an exaggerated view of the badness of the climate of these islands. But when I reflect on the almost universal covering of peat, and on fact of wheat seldom ripening here, I can hardly believe that the climate in summer is so fine and dry as has lately been represented.

The last few days in Port Louis harbour seem to have been frustrating. The *Adventure*, bought by Captain FitzRoy and newly fitted out for survey work[7] sailed to continue surveying at 10.00am on 30 March, just as the crew of the *Beagle* were preparing to "muster by divisions". Darwin lamented: "We are detained owing to some prisoners who are in irons on board: we are waiting till a cutter returns which will be chartered to take them to Rio". (*See page* 38.)

The ship's log confirms that Channon had been received on board on Sunday 16 March, and Rivers on Tuesday 18 March, while Darwin was away. Luna was brought on board on the morning of Saturday 5 April. In fact, according to FitzRoy, only Rivers (Rivero) was kept in irons permanently. There were other causes of delay: the weather continued very bad, a French whaler limped in with a damaged rudder and a mutinous crew who wished to desert their vessel and live on land. The situation at Port Louis, because of the murders, and the political insecurity, was extremely strained, and another group of mutinous sailors was *not* what was needed for the peace of the little community, and, as Darwin put, it, the officers of the *Beagle* were "obliged to bully them, and finally to see the vessel on her way to Rio de Janeiro". And then there was the body of Lieutenant Clive to be dealt with (*see page* 41).

Darwin did his best to make constructive use of his time:

> My time passes very evenly; one day hammering the rocks;

another pulling up the roots of the Kelp for the curious little Corallines which are attached to them.

In fact Darwin seems to have undertaken quite a good deal of geological fieldwork during the period 20 March-6 April. He re-examined some of the geological exposures around Johnson Harbour, and note-book entries confirm that some geological survey work was done of Sunday 23, Monday 24 and Sunday 30 March. Although the entries are cryptic and at times difficult to decipher, occasional fragments of description are decodable. For example, one entry reads:

Sunday S < 38°, most general SSW < 45° . . . granual quartz rock
These crests W & E
Valley of blocks of ¼ of mile broad
inclining of 10° from plain, [flowing?] like lava
on crests detached Blocks.
great earthquakes

This might be interpreted to imply that on Sunday 23 March Darwin examined the ridges of quartzite hills south of Berkeley Sound, noting that the general trend of the crests of the hills was west to east, and dips were generally to the south, but sometimes had a westerly component, at angles of 38-45°. He seems to have encountered the massive stone-run of Prince's Street, noted its angle and followed it "upstream" to places near the crests of the hills where massive blocks of stone were becoming detached. He speculates that great earthquakes might have been responsible. Possibly Darwin camped out overnight, for the next day sees him working in the area south of Prince's Street. A page of calculations in his field note-book seems to be his attempt to compute the height of Mt Estancia (960 ft), and drawings of folded rocks seem to be of structures in the Mt Estancia – Mt Vernet Range (now in Mt Kent Paddock). A few pages later another Sunday entry appears (probably 30 March). This finds Darwin "walking up dome" and a series of sketch-maps and diagrams leaves little doubt that he was conducting a careful survey of the anticlinal structure on Long Island Mountain that he had examined a year before. The phrases "Nearly as high as central chain . . . Great long hill . . . long wave . . . more regularly anticlinal . . . in parts like crater . . . fragments

as big as churches . . . valleys on each side a mile wide" leave little doubt as to the locality and the phrases: "most amazing scene . . . wonderful scene of violence" bear witness to the extent that these landforms impressed him. From close to the summit of this range of mountains he seems to have viewed the landscape in all directions:

3 ranges between Berkeley Sound
& Sea . . .

Hills North of B Sound fewer crests (W & E)
Centre of Island more confusion

Presumably Darwin was seeing the generally west-east trend of the ridges north of the Sound, and noting the somewhat confused mass of stone-runs towards the south. And there are indeed three ranges of hills between Berkeley Sound and the sea, southwards at Port FitzRoy, assuming that Mt Kent is considered part of the main range. The weather and visibility must have been a good deal better than it had been a fortnight before when he trekked overland to Choiseul Sound.

Returning towards the ship, Darwin noted "Thrushes in flocks". Flocks of Falklands thrushes (*Turdus falcklandii*) remain common on the broken ground, around Prince's Street and in amongst the lichen-grey boulders of the stone-runs along the flank of Long Island Mountain. He also noted vultures (they too, still hover overhead of any intruder to their domain) and "a small hawk . . . feeding on carrion".

Probably a substantial portion of the notes on marine biology in the Zoological Diary dates from these last few days of the sojourn at Berkeley Sound. Besides collecting shells along the shore (Fig 3.6), Darwin described in detail many of the organisms living in the kelp beds; he made a few notes on barnacles, which were to be a group of which he made a very detailed study later in life.[8]

The cutter that was to take the prisoners and Luna (the King's evidence) had not returned as planned, and as Darwin put it "to our great sorrow" they had to remain aboard the *Beagle* for transfer. At 7.00pm on Saturday 5 April the ship was shifted from the Port Louis anchorage to a point just off the eastern end of Long Island with "Best Bowyer in 8 fathoms"; for some reason this cannot have been entirely satisfactory, for early the next morning the berth was shifted again to between Long Island and Sea Lion Rocks (see Fig

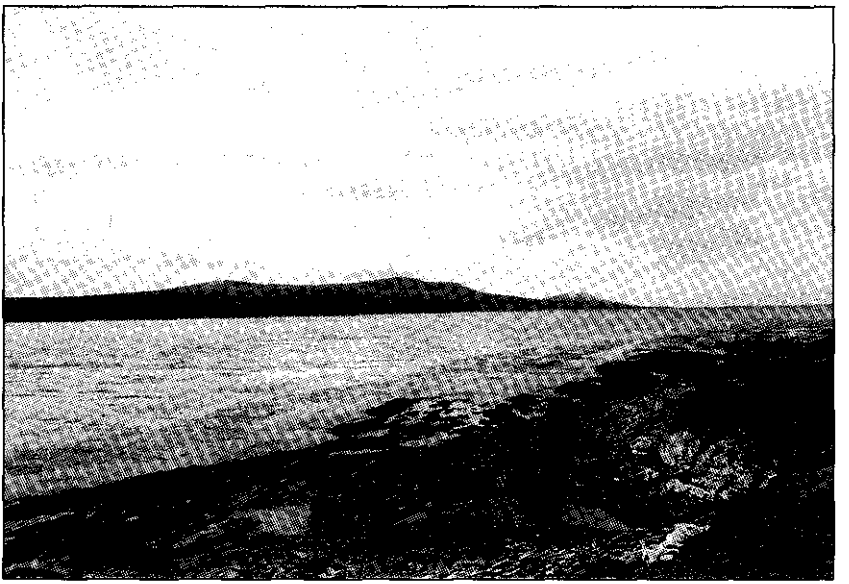


Figure 3.6. Shore of Johnson Harbour, Berkeley Sound. Darwin spent many hours collecting shells and other marine invertebrates along this coast. Photograph: Patrick Armstrong.

2.2). Eventually Darwin was able to record "April 7th. Finally weighed our anchor on our passage to the coast of Patagonia".

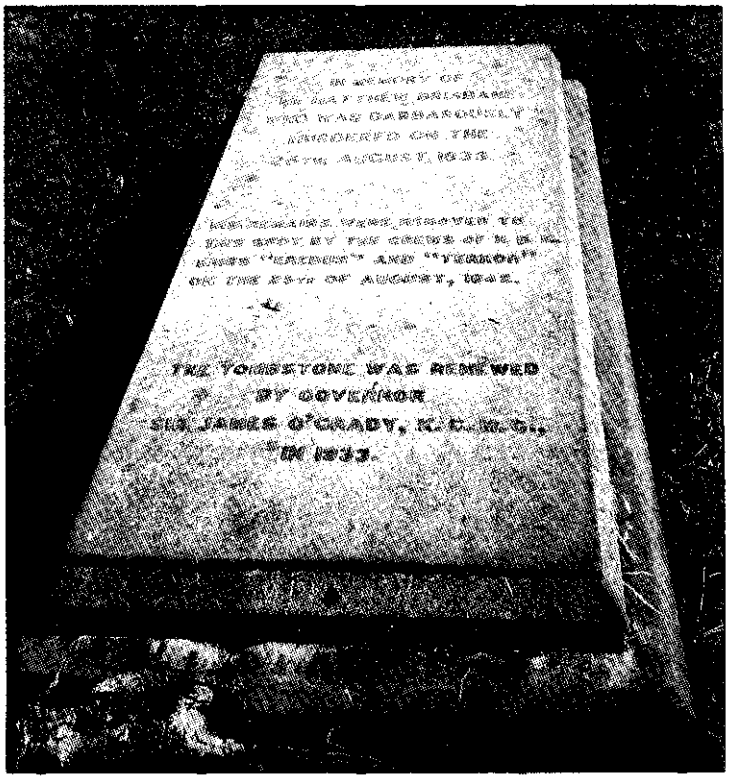
Actually, at 9.30, on 7 April, the log records that the ship "weighed and made sail to top gallant sails, and hove to for the French whaler". Captain FitzRoy was waiting, wanting to be sure that the Frenchmen left. He need not have worried; by 10.00am the two vessels were sailing in company out of the mouth of Berkeley Sound. The two vessels sped northwards past Volunteer Point and Cape Carysfort, until sight was lost of the French ship at 2.30pm., and of the "Extremes of land" to the south and south-west at 4.00pm.

Darwin's final notes on the Falkland Islands were as follows:

> Having thus removed two of the worst prisoners, there are little fears for Mr Smith's safety. Two Gauchos yet remain free, & they are to be trusted: with their assistance sufficient wild cattle can be caught for the subsistence of the Colony.
>
> Perhaps this may be the start in that prosperity which these islands must ultimately obtain.

As in many other matters, Darwin was surprisingly prescient. It was indeed with the help of gauchos that a beef industry was built up, especially in the 1840s. Later the cattle were replaced by sheep. The discovery of gold in California 1848 and in Australia in 1851 sent dozens of Cape Horners into Falkland Island ports, and a period of relative prosperity ensued. Wrecks of some of these Cape Horn sailing vessels that never reached their destinations remain in many an inlet, dark brown timbers decaying slowly in the cold air, protruding tombstone-like from the quiet waters, monuments to those boisterous days.

But it does not seem that Darwin's two gaucho friends stayed to share in the minor boom. A census of the inhabitants of Port Louis in 1842 shows that they had departed.



The grave of Matthew Brisbane, Port Louis, renewed in 1933. Photograph: Patrick Armstrong

Chapter 4

Geological Observations

Darwin's approach to his geological work

The many dozens of pages of Darwin's geological annotations on the Falklands from the *Beagle* and immediately post-*Beagle* periods illustrate superbly the breadth of his geological interests. Space prohibits a detailed discussion of every site visited, and every concept employed during his explorations. Emphasis will be placed on about five themes that were of particular importance in Darwin's descriptions of Falklands geology, and that appear to be of significance in relation to his later work. In considering them we should recall that although Darwin's formal training in science had been fairly minimal, he had had some instruction and experience in the use of the transect method with Professor Adam Sedgwick in the hills of North Wales in the summer between coming down from Cambridge and joining the *Beagle* (*see pages* 14–15). This had a considerable effect on the manner in which he recorded and thought about Falklands geology.

Thus although he made a number of separate excursions from HMS *Beagle* during the two visits, he describes the geology of the region in terms of a single transect across the stretch of country he explored. He uses the technique in a substantial part of his 1834 account of the geology (DAR 32.2/136ff):

> I will detail what is met with in an irregular & N & S line, which crossed the head of Berkeley Sound. – We have seen that [to] the North of this bay there are many parallel low crests, which all dip to the S by W at an angle from 40° to 50°. After crossing Berkeley Sound, which is fringed on each side by slates & the "passage rock". – We then come to an E & W range of hills . . . .

and so on.

These notes were clearly used as the basis for his 1846 paper in the *Proceedings of the Geological Society*, although the style has been polished and a few details changed:

> In crossing the eastern island in a N.N.W. and S.S.E. direction, in a line intersecting the head of Berkeley Sound, we find north

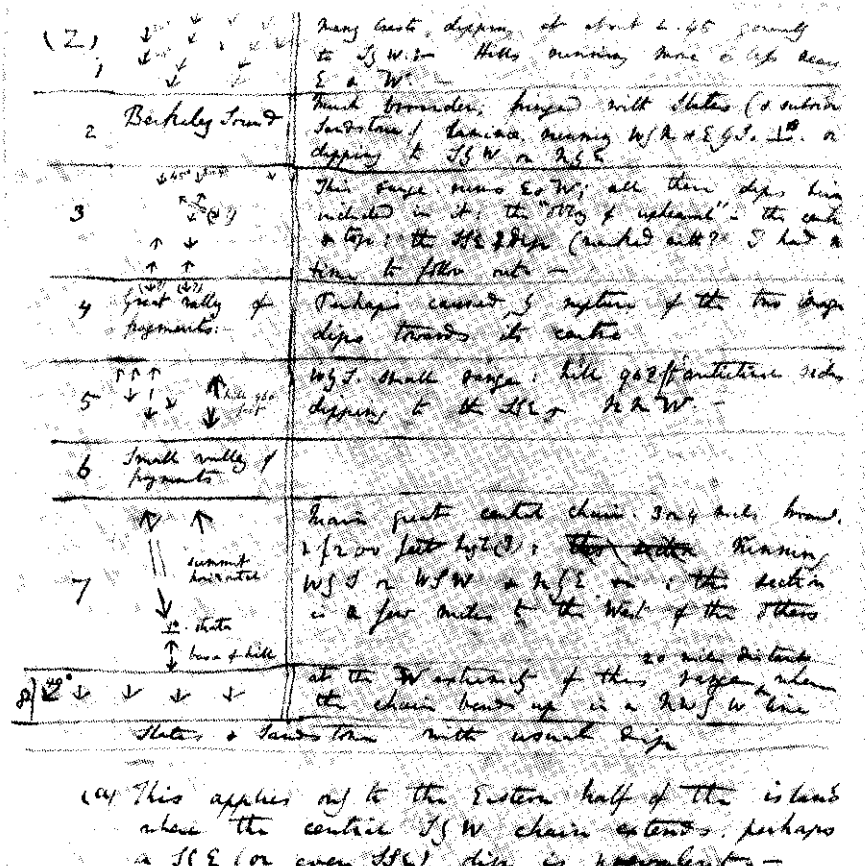


Figure 4.1. Darwin's interpretation of the geology of the Berkeley Sound area, in terms of a series of parallel strips running approximately east–west. Photograph: Cambridge University Library.

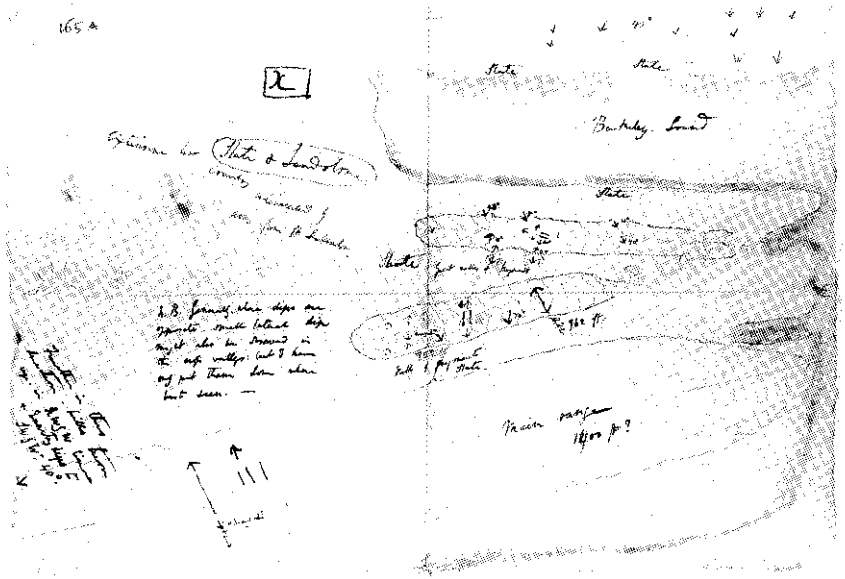


Figure 4.2. Darwin's crude geological sketch-map of the Berkeley Sound region. Note the angles of dip of strata, the notes on rock-types. The "Zone of upheaval" or dome structure, and the "Great Valley of Fragments" (Prince's Street) are to the south of the Sound, in the centre of the map. Photograph: Cambridge University Library.

> of it several low, parallel, interrupted, east and west ranges, with strata all dipping a little west of south, at angles varying between 20° and 40°. South of Berkeley Sound the first range we come to is a short one, rising like the others through the clay-slate formation.

Darwin's notes and his 1846 article are illustrated by a number of cross-sections (see Figs 4.5, 4.6, 4.8, 4.9); the 1834 "East Falkland Isd (Appendix)" notes include a table, which shows the geological structure of East Falkland as a series of parallel east-west strips (Fig 4.1); a crude sketch-map prepared at about the same time emphasises the same idea (Fig 4.2). Clearly the transect-and-cross-section mode was fundamental to the way in which Charles Darwin collected and arranged geological data. See also Fig 4.3.

Structure, tectonics, cleavage and metamorphism

The highly complex structure of East Falkland was of intense interest to Charles Darwin. The "little note-books" with their

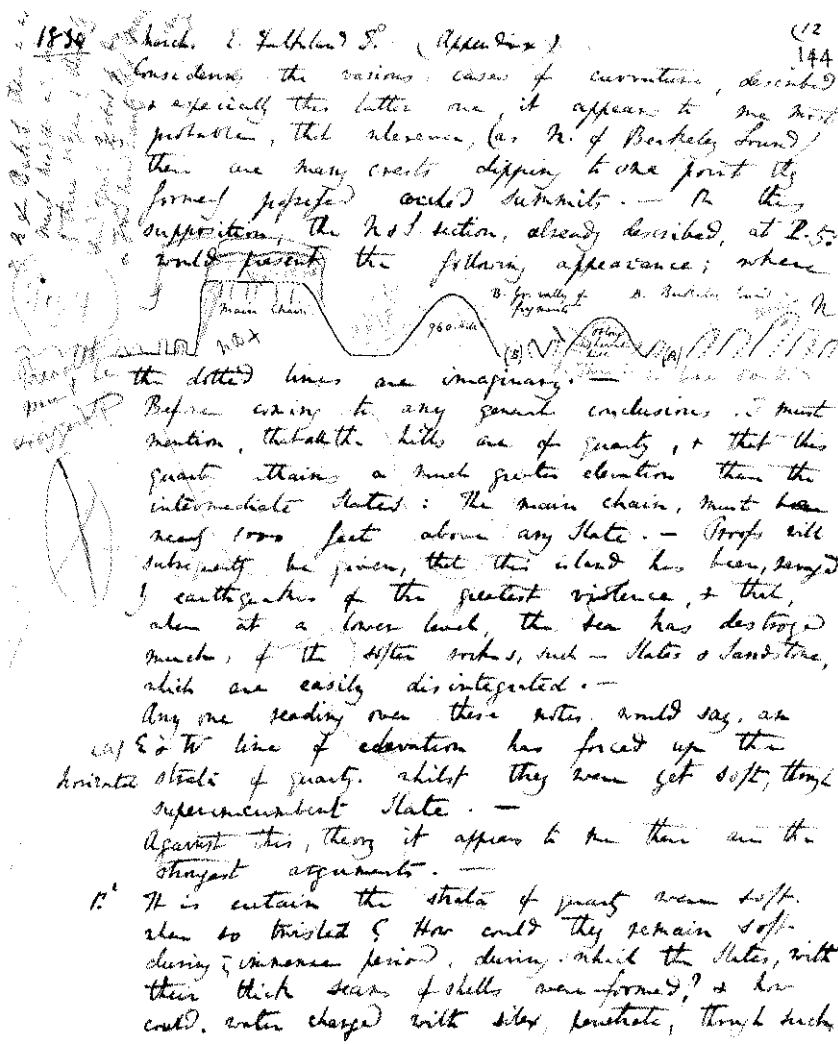


Figure 4.3. A passage from Darwin's geological notes on East Falkland, showing a cross-section northwards from Berkeley Sound. Photograph: Cambridge University Library.

Figure 4.4. Slaty cleavage, cutting across lines of stratification, East Falkland. Photograph: Patrick Armstrong.

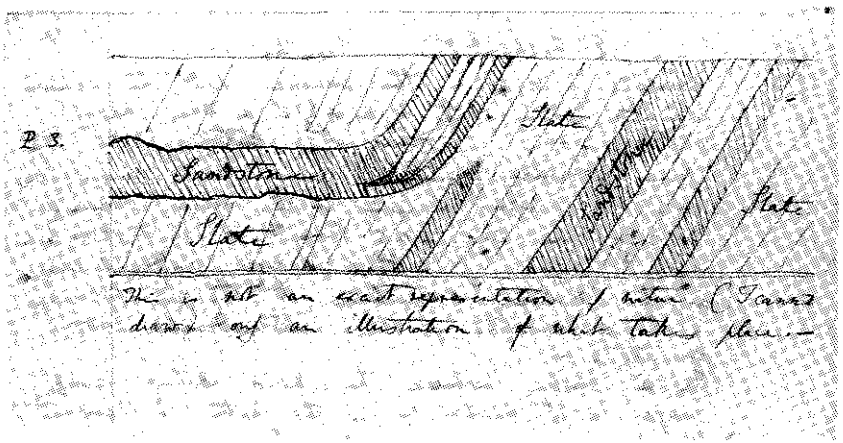


Figure 4.5. A sketch-section from Darwin's geological notes. "[H]ighly inclined layers of sandstone bending at their lower extremity & joining on to the horizontal." Photograph: Cambridge University Library.

observations actually made in the field in 1833 and 1834, and all subsequent manuscripts abound with mentions of angles and directions of dip, strike and cleavage, speculations about which rocks overlaid others, and relationships between topography and structure. Sketches showing the highly complex fold systems that he encountered appear in the "little note-books", in the 1833, 1834 and subsequent manuscripts (*see pages* 8–11), as well as in the 1846 Geological Society paper. Although it is not always easy to follow Charles' descriptions or argument where it concerns structural geology, the reader cannot fail to be impressed at the wealth of detail he recorded.

Darwin correctly deduced that there were two distinct formations. He also noticed that in places the planes of cleavage seemed often to cut across the planes of stratification (Fig 4.4). These cleavage planes occasioned Darwin certain difficulties:

> I may mention as proof of the extreme difficulty in ascertaining the stratification of Clay slate, that in a low cliff there were numerous, smooth equidistant planes of division, in

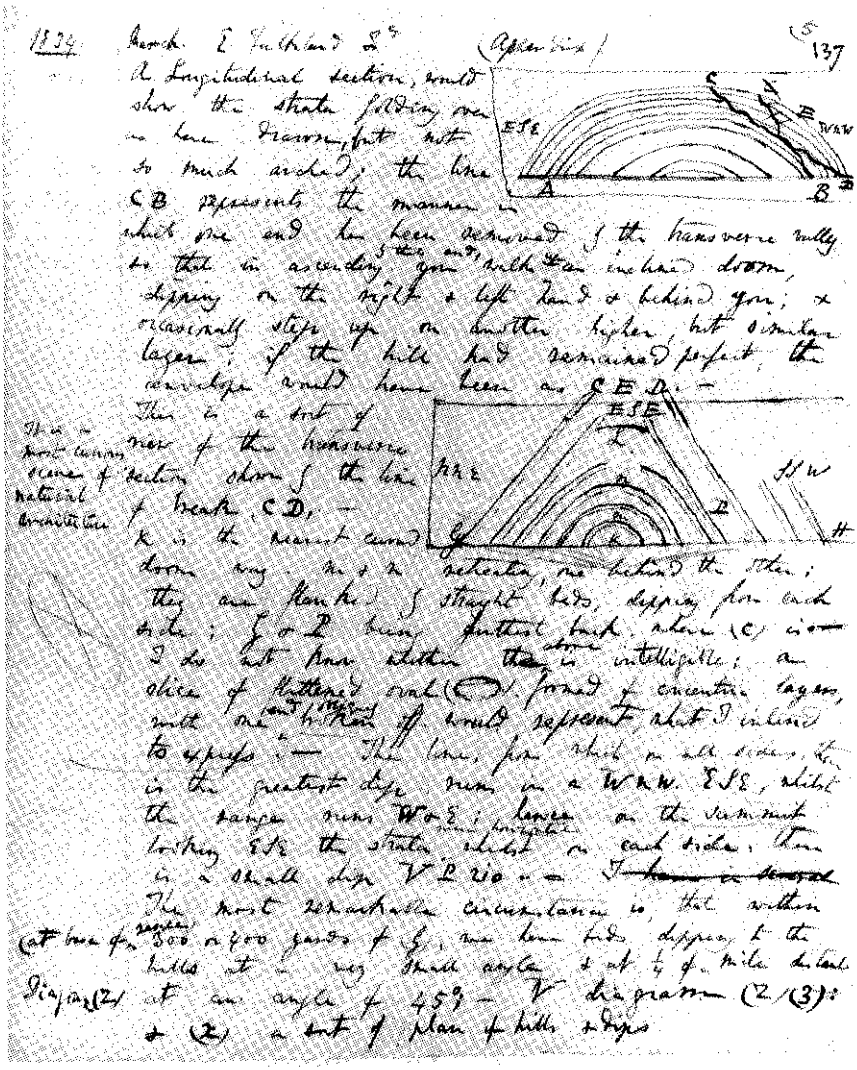


Figure 4.6. Page from Darwin's geological notes, showing cross-section diagrams of the dome structure of south Berkeley Sound. Compare Figs. 4.14 and 4.25. Photograph: Cambridge University Library.

Figure 4.7. Fold structures in the quartzitic sediments of the Mount Vernet Range, East Falkland Photograph: Patrick Armstrong.

> addition to the ordinary cleavage which dipped at an angle of 35° to NW by N, at the time of first meeting these fissures, I did not know of the sandstone & therefore imagined that they were true strata.
>
> (DAR 33/169–170)

> The beds of sandstone vary in thickness from two or three inches to as many feet . . . almost universally they are covered above & below by highly inclined laminæ of slate which run in their usual direction. The sandstone rock, where organic remains are not present, splinters at right angles to the stripes & natural planes of division. This . . . often rendered the obtaining of the fossils more difficult. I am inclined to attribute this to the same principle which has given the interbedding slate its vertical cleavage.
>
> (DAR 32.2/126)

He perceptively commented on the relationship between pressure-induced cleavage structures and mineralogical change, and the commonalty of the direction of these phenomena with the grain of the topography of the islands. In a set of notes on the subject of cleavage (DAR41 *Cleavage Notes*/16), dating from the *Beagle*

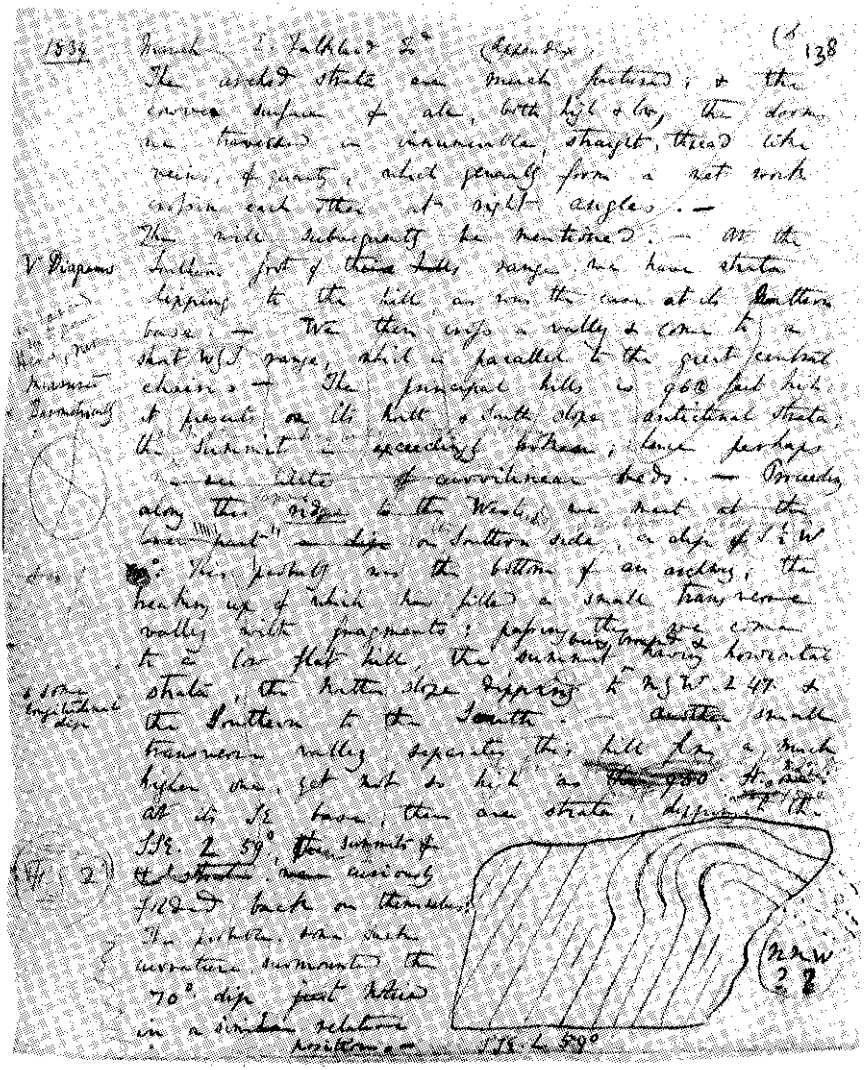


Figure 4.8. Darwin's annotations on folding, East Falkland, 1834. Photograph: Cambridge University Library.

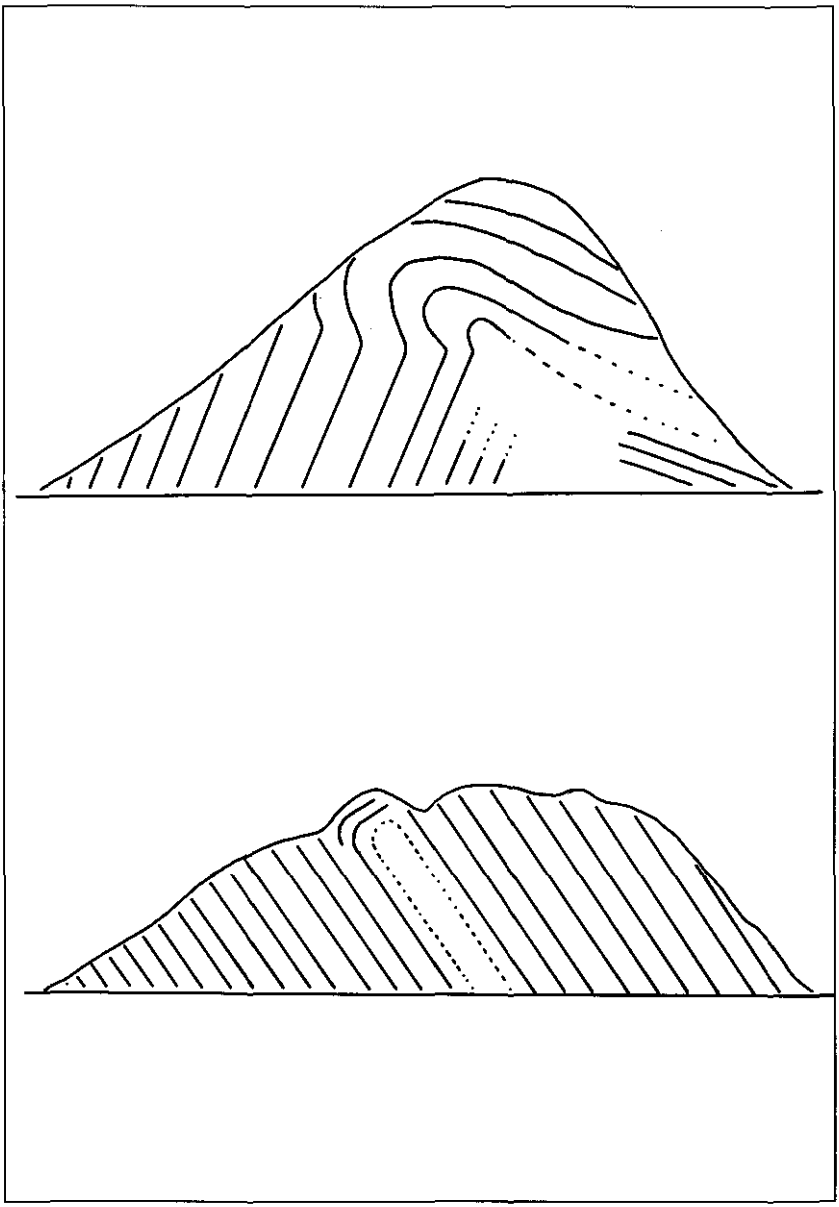


Figure 4.9. Cross-section from Darwin's 1846 Geological Society Paper on the Falkland Islands.

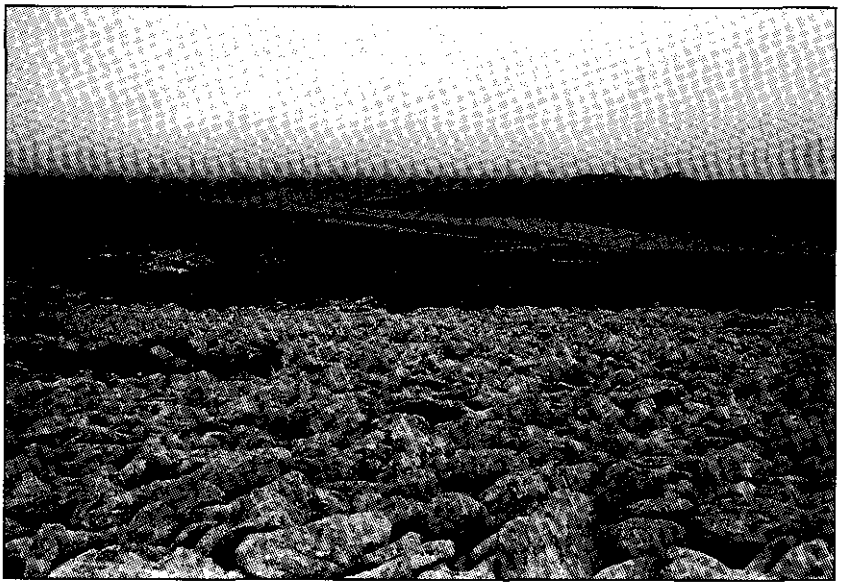


Figure 4.10. Stone-runs, East Falkland. Photograph: Patrick Armstrong.

Figure 4.11. Quartzite blocks, Prince's Street, East Falkland. Photograph: Patrick Armstrong.

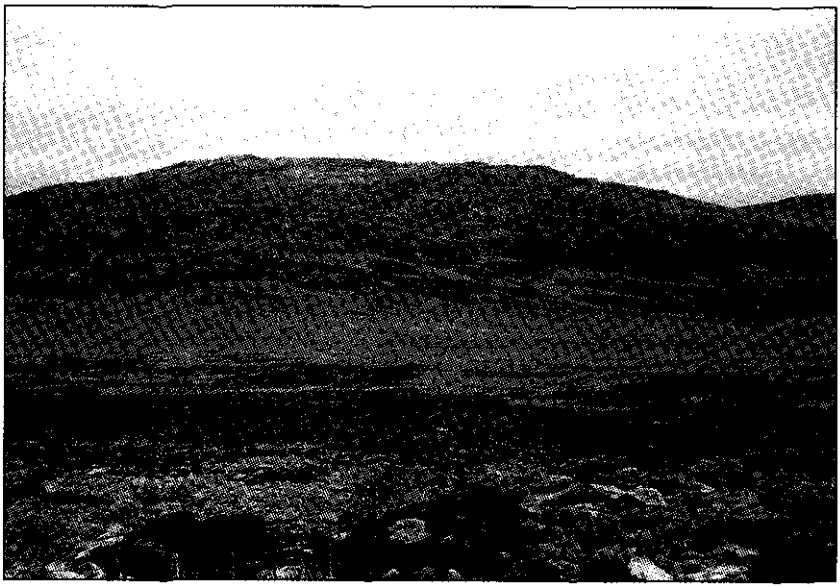


Figure 4.12. Prince's Street stone-run from the north. Photograph: Patrick Armstrong.

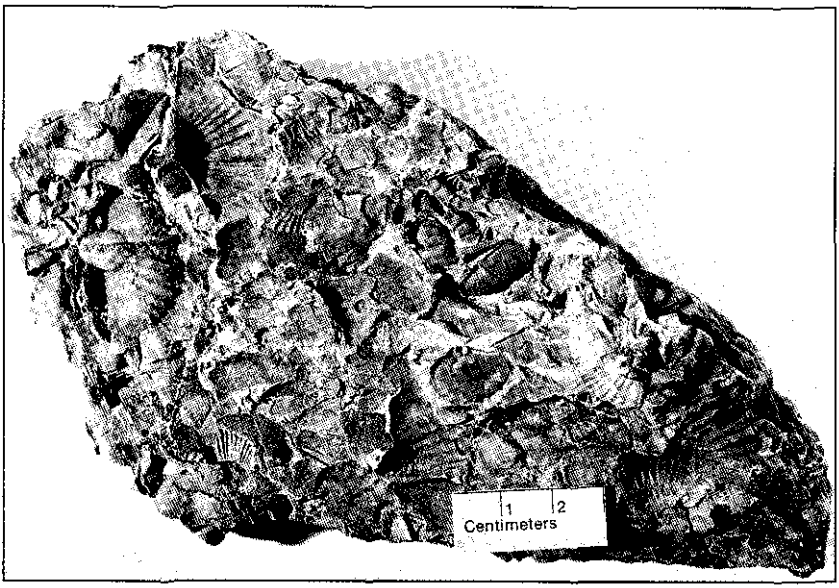


Figure 4.13. "Rocks . . . abounding with shells . . . of the most interesting geological aera." Sandstone containing fossils, mainly brachiopods from Port Louis, East Falkland. Photograph: University of Western Australia.

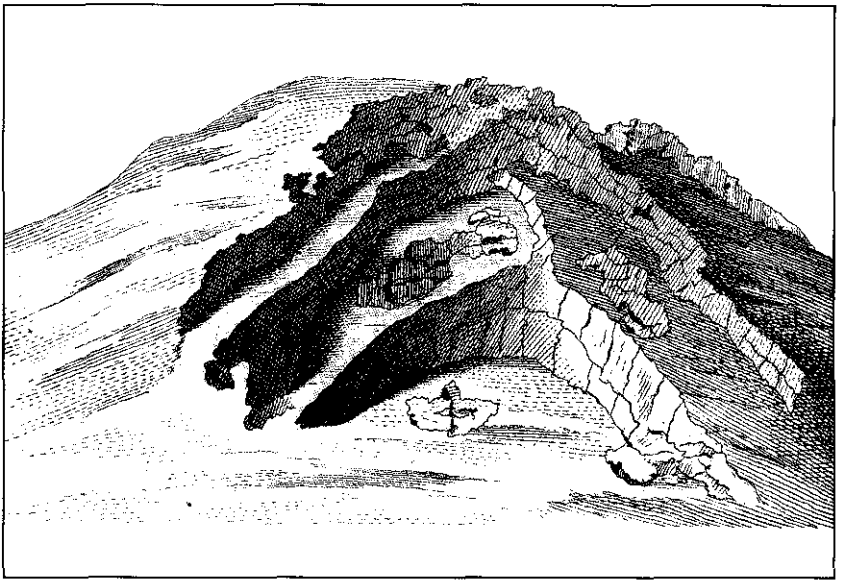


Figure 4.14. The dome structure or "zone of upheaval", as it appears in Pernety's 1770 account . . . Photograph: Cambridge University Library.

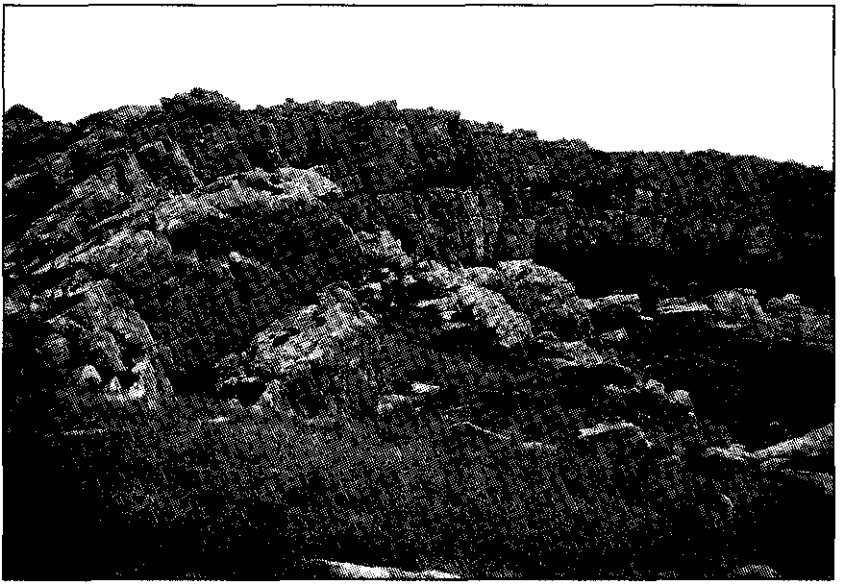


Figure 4.15. . . . and as it appears in 1989. Compare Fig. 4.6. Photograph: Patrick Armstrong.

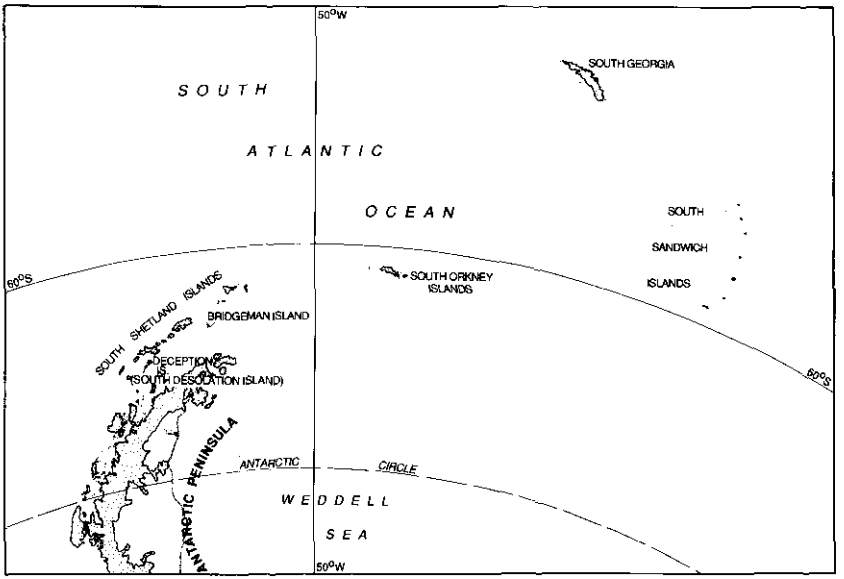


Figure 4.16. Map showing places in the peri-antarctic visited by Brisbane, and that he discussed in conversations with Darwin in 1833.

period he wrote:

> I will however begin with the Falkland Isds situated nearly in the same latitude [as Patagonia]. In these islands the Mineralogical nature of the rocks is characterised by much simplicity, whilst their mechanical structure is both complicated and extraordinary. One direction W 15° N, is generally common, to the nearly vertical lamina of Clay Slate, to the inclined strata of Quartz Rock, to the lines of the principal hills, & to the general configuration of the land. – From what I understand of the Geology the Ranges of Quartz Rock, appear to point out lines of Metamorphic action, – Where the [common *del*] ordinary direction varys [sic] the same variation appears to occur in all the above phenomena.

A little earlier he had written:

> From what I have mentioned both with respect to the Sandstone & quartz it appears that the general point of dip is within some degrees of SSW. The direction is WNW & ESE: this is common to the ranges of hills & the valleys. – also the Sound & its arms

run in this line, & islands in it equally show the accuracy of the WNW direction of stratification. –

(DAR 32.2/129)

The unusual and the bizarre always had a keen fascination for Darwin, and he describes how in a few places he encountered a situation where in a single exposure, cleaved slates lay above and below a sandstone stratum, this passing laterally into a situation where bands of slate and sandstone trended in the same direction (see Fig 4.5):

. . . in more than one section, I saw the extremities of the highly inclined layers of sandstone bending at their lower extremities & joining on to the horizontal. – or it might be described that the horizontal sandstone thinned out & the extremities of the beds were caught up between the inclined layers of the slate. – . . . Hence it is certain that the power of cleavage has separated the constituent parts of Slate & Sandstone, from the [fluid *del*] water in which they were suspended & formed them into <u>even</u>, parallel beds & laminæ.

(March 1834, DAR 32.2/129)

But he noted with equal precision small scale features, such as subtle changes in rock type, for, also in March 1833, he carefully traced the transition from one rock-type to another along the shore of Johnson Harbour:

Where the alumino-quartz approaches the slate district it becomes more earthy & ferruginous in its nature; by degrees it passes into (1083) a pale coloured slate, divided into fine laminae; although the change is so great, yet its steps are so gradual, yet it is impossible to fix upon any one spot. Specimen (1135) is perhaps as intermediate in its character as any that could be found.

(DAR 32.2/124)

Revisiting the same site a year later, and collecting further specimens he noted "All these specimens passed by the finest gradations into each other; & are here seen only as steps in the series". His use of the phrase "abortive attempt of form gneiss", however, suggests that he may have considered that metamorphic change to have occurred relatively quickly (see also some com-

ments on Darwin's catastrophist outlook, on pages 90–97).

Darwin was particularly impressed by the complex patterns of anticlinal (upfold), synclinal (downfold) and isoclinal folding (steep folding where both limbs of each fold dip in the same direction) in the east-west ranges of East Falkland, and includes several sketch-maps and diagrams of the conspicuous dome-shaped structure on the flanks of what is now known as Long Island Mountain (in Top Square Paddock). He refers to this structure as the "zone of upheaval", "oval of elevation" or "oblong of upheaval" (see Fig 4.6). After mentioning the generally southerly dip of the strata, Darwin, ever observant of the unusual or strange, wrote this in his 1833 Geological Notes:

> There is however one curious exception to this dipping in one direction: it occurs within a regular range of quartz (it was where specks of mica were found), which dipped to S ½, W at an angle of 19°. It would seem as if the line of elevation had been a point (or rather oblong) of upheaval, from which the strata on all sides dipped; at four nearby opposite points the following were dips:- on North side to N ½, E 28°; on East ENE, 14°; on South to S by ½, W, 29°; on West to W by N ½ N, 16°; the four stations were chosen where strata were best seen. – On the top of the [cone *del*] oblong the strata were nearly horizontal & on the East side the dip was least regular . . . the strata were much broken, & the upper ones were cracked & widely separated; especially on the west side, where you might ascend in a broad crack on the curved dome of strata.
>
> (DAR 32.2/128)

Here is a revised, rather more vivid, description of the feature, written some time later. Note the same reliance on the transect approach, and the way is which he clearly envisages the structure in three dimensions:

> Having crossed over a flat tract of such formation [clay-slates with sandstones] we arrive at an E & W range of Quartz Hills, the strata of which present, as before their basset edges to the North. The structure of one part of this ridge is very remarkable; a convex hillock is formed by curved strata, which dip away on all sides. The description will be rendered more clear, if we imagine in a line of elevation crossing yielding pliant

strata, that a small definite portion could be raised above the general level; the effect would be to form a low oval mound, entirely constructed of folding concentric layers. Such is the structure of this spot; & if the mound had remained unbroken, the surface would have shown a smooth arched dome. One end however has not only been broken off, but is slightly hollowed out; hence ascending by that point, the fractured ends of the successive strata form so many inclined steps; & the staircase on each hand in is parts flanked by a wall, the stones of which dipped away in opposite directions. – The scene on a small scale presented a curious exhibition of natural architecture. The summit of the mound, from the strata being horizontal, was nearly flat & about one hundred yards wide. From the "oval of elevation", if such an expression may be used, the strata declined on every side.

(DAR 33/181–182)

See Figs 4.6, 4.14 and 4.15.

During his second visit to the Falklands, Darwin ventured further south, encountering further examples of complex fold structures in the Mt Vernet Range south of Prince's Street (see Fig 4.7 and 4.8); these too he sketched in his little note-book (1.18), and described in some detail in his 1834 Notes (DAR 32.2/138 etc [Fig 4.8] and also 33/181–182). The account below presented to the Geological Society in 1846 represents a considerable compression:

Proceeding in our southern course, a second short east and west range is met with, formed of three principal hills, of which the first (960 feet high) is anticlinal with a broken summit. The second hill is also anticlinal with horizontal strata on its broad summit, showing traces of curvature towards the edges: the inclination is rather greater on the south rather than the north side. Between this second and third hill there is an anticlinal hillock, the strata on its south side dipping at an angle of 59°, and its summit folded as represented in the diagram. We here see that the upper part of the axis-plane, to use a convenient term of the Professors Rogers, has been pushed over to the south. Throughout the third hill the strata at first appear all conformable, dipping from 50° to 55° N. by E.; but on examination I found a small portion, only fifty yards across the

line of the dip, inclined at an angle of 26° southward; and the tips of the adjoining beds were as represented in the diagram, abruptly arched. Hence this hill has been formed by a mass of strata doubled over on themselves, with the axis plane thrown quite over to the south, as was the case with the upper part alone in the above-mentioned hillock.

(*Proc. Geol. Soc.*, vol 2, (Pt 1), 25 March 1846, page 272.)

Darwin's understanding of the structures is again influenced by his transect approach, and the facility with which he sets out his material in terms of a series of cross-sections (see Fig 4.9). Both are obvious enough to a modern geologist, but ideas that Darwin might have been without had it not been for those days in North Wales with Professor Adam Sedgwick.

The stone-runs

Among the most conspicuous elements in the Falklands landscape are the stone-runs – more-or-less linear, almost glacier-like streams of jumbled, angular, generally quartzitic boulders that run along many of the valleys and down many of the valley sides. The slabs of which they are composed vary from about 20cm to several metres in length, one metre perhaps being typical (see Fig 4.10). They seem to have been formed as the result of *peri-glacial* rock-shattering and *solifluction* movement in the Quaternary, although, the genesis of these important geomorphic features has been the subject of a good deal of discussion and dispute.[1]

Darwin mentions a "valley of the fragments" in his notes on his first visit to the Falklands, but he made a more detailed study when he returned in 1834. His account in *The Voyage of the Beagle*, based on the massive stone-run now called Prince's Street (Figs 4.11 and 4.12) between the Long Island Mountain and Mt Vernet uplands, has been much quoted, but as it differs slightly from the vivid description given in his original geological notes, the latter will here be quoted in full.

In very many parts of the island, the bottoms of the valleys are filled up with an astonishing number of large angular fragments of Quartz. These are so excessively numerous that I am at a loss to describe the appearance presented by them. – The blocks

vary in size from a man's chest to 10 or 20 times that size; & of course occasionally much larger; they must in many places form a mass of considerable depth; the water is often trickling deep below, & of course in the centre of the valleys it would soon fill up the crevices of these blocks & thus raise its bed. The Peat on each side is daily diminishing the apparent breadth which must vary from a few hundred yards to more than a mile; In the great "valley of the fragments", as we called a valley it is necessary to cross by jumping from stone to stone an uninterrupted band about half a mile. But the most curious is the very little inclination of these streams of blocks; (even a mail coach would not alter its speed in ascending the inclination). – The more inclined beds on sides of hills I saw dipping at 10°; but in the broad flat valleys, in many places they are only [impercep *del*] just more than imperceptibly inclined. – They can often be traced to the crest of hills, where masses as large as churches have been arrested in their course; the curved plates of the arch-ways lie in immense quantities at the very source; the scene is like a ruined castle, which formerly commanded the pass. – For the valleys of little inclination, another simile will give a very faithful idea of the appearance; it is as if from every point in the mountains great streams of white trachytic Lava had burst forth & that there had subsequently been torn into a myriad fragments. – Every one talks of the "streams of blocks". –

(DAR 32.2/147–148)

There were a number of features of the stone runs that Darwin did not understand, and some of the aspects to which he drew attention have even now not been explained in an entirely satisfactory manner. How could the continuance of the streams of stones right to the summits of hills be explained?

In some places a continuous stream of these fragments follows up the whole course of a valley & even extends to the very crest of the hill: there, huge masses, exceeding in dimensions any small building seem to stand arrested in their headlong course. . .

(DAR 33/205)

Darwin seems, however, on the whole to have felt that the features were caused by earthquakes:

> . . . it seems . . . probable that they [the fragments] have been hurled down from the nearest slopes; and that since, by a vibratory movement of overwhelming force, the fragments have been levelled into one continuous sheet. If during the earthquake which in 1835 overthrew Concepcion, in Chile, it was thought wonderful that small bodies should have been pitched a few inches from the ground, what must we say to a movement which has caused fragments many tons in weight, to move onwards like such so much sand on a vibrating board, and find their level?
>
> (*Voyage*, page 189)

This was written after his own experience of an earthquake in South America. He had earlier written:

> . . . never did any scene like the "streams of stones" so forcibly convey to my mind the idea of a convulsion, of which in historical record we might in vain seek for any counterpart.[2]
>
> (DAR 33/209)

However there is some very slight evidence that he was not quite so certain in his own mind as he appeared in his writings. In the field note-book used in 1834, surrounded by notes that clearly refer to a stone-run, almost certainly Prince's Street, such as:

> Valley of blocks ¼ of mile wide, inclination 10° from that to plain . . . on crests detached blocks

is the fragment:

> Degradation of rocks by snow??

and a few pages further on appear the words:

> *Degradation of land by snow.*

The repetition of an idea within a short space, while not unique within Darwin's notes, is striking. Clearly there occurred to Darwin, exposed to snow and bitter weather himself, the possibility that that these conditions might affect the land. Yet he does not develop the idea at all in his Falklands geology notes.

But 46 years later, we find Charles Darwin in correspondence with Professor James Geikie (1839–1915) on the subject of "drift" deposits – till, loess and "head", and their relation to the frozen, snowy environments of the British Quaternary. There are several letters that include passages that touch on the topic. For example, in one, Darwin mentioned the "immense mass of closely packed broken and angular flint; in which the skull of the musk ox & woolly elephant have been found" on the chalk escarpment near his home at Down in Kent; he went on:

> This great accumulation of uneven flints must therefore have been made when the climate was cold, & I believe it can be accounted for by the lower valleys being filled up during part of the year with drifted frozen snow, over which rubbish from the upper parts was washed.
>
> (Charles Darwin to James Geikie, 19 July 1880; DAR 144)

This account would correspond closely, although not exactly, with the view of a modern geomorphologist. Such deposits are now described as *periglacial* (ie formed in very cold environments close to ice-masses), by processes involving *cryogenic* or frost weathering and *solifluction*, a process defined by J G Andersson to describe the "slow flowing from higher to lower ground of waste saturated with water" which he observed actually in the Falkland Islands. It has subsequently been applied to slow, gravitational downslope movement of saturated, seasonally thawed material, under cold climatic conditions.

In a letter a few months later Darwin wrote to Geikie to say that a subject that interested him a great deal was:

> . . . the sliding & travelling of angular debris. Ever since seeing the "streams of stones" at the Falkland Islands – I have felt uneasy in the mind on this subject. I wish Mr Kerr's notion could be fully elucidated about frozen snow. Some one ought to observe the movement of fields of snow which supply Glaciers in Switzerland.
>
> (Charles Darwin to James Geikie, 13 December 1880, DAR 144)

It is easy to accuse the elderly Darwin here of "being wise after the event", but there is some further evidence that he was, even at the time of the visit to the Falklands, or shortly after it "uneasy in the

mind". When Darwin was editing his voyage writings for his book *The Voyage of the Beagle*, Darwin included, at the end of the section on the stone-runs of East Falkland, almost as an afterthought, a note of his uncertainty about their origin; he also appears to have been comparing, in a rather vague way, these features with the erratic boulders scattered by glacial action over northern Europe:

> . . . never did any scene, like these "streams of stones," so forcibly convey to my mind the idea of a convulsion, . . . yet the progress of knowledge will probably some day give a simple explanation to this phenomenon, as it already has of the so long-thought inexplicable transportal of the erratic boulders, which are strewed over the plains of Europe.
>
> (*Voyage*, page 189)

We thus see the young Darwin scribbling remarks on snow as a geomorphic agent while he was in the Falklands with stone-runs all around him. We see him as an aged scientist discussing "frozen snow" and freeze-thaw processes almost "in the same breath" as saying he had felt "uneasy in the mind" on the subject ever since seeing the Falklands stone-runs. It rather looks as though beneath the dramatic speculations about the "streams of stones" being formed by earthquakes, which Darwin developed in his own notes, and to which he gave prominence in *The Voyage of the Beagle*, was the hardly-formed and almost entirely unexpressed notion that more gradual snow-action might have something to do with the matter. Within the catastrophist, as early as March 1834, a uniformitarian was already lurking.

Changes in sea level

The idea that the levels of land and sea had changed in relation to one another recurs again and again in Darwin's geological notes. In his descriptions of both eastern and western South America, the Pacific Islands, Tasmania, Western Australia and Mauritius, for example, Darwin records evidence that the sea in the not too far distant past "stood higher" or "stood lower" in relation to the land. The idea of a sea-level rise was an integral component of his first integrated gradualist conceptualisation – the coral atoll theory. It is thus worth scrutinising the writings from the Falklands periods to

see whether the concept was already in use during the southern hemisphere autumns of 1833 and 1834. It was; but not quite in the form in which one might expect:

> When at a lower level, the sea has destroyed much of the softer rocks, such as Slates and Sandstones which are easily disintegrated.
>
> (March-April 1834; DAR 32.2/144)

Darwin seems emphatic that it was the sea, not rivers that had carved out weaker rocks. He describes the landscape south of the main range as

> . . . like a plain but in truth it is remarkably undulating like waves of the sea; these valleys are generally parallel to the main chain; but they are oftentimes intersected by winding arms of the sea.
>
> (DAR 32.2/150)

A note is added at this point:

> According to my hypothesis, lines of mineralogic change might be expected parallel to these valleys – hence, when the surface was beneath the sea the softer parts would be scooped out in these lines.

Darwin seems to have been thinking in terms of a very broad regional uplift, associated with folding and metamorphism. Almost his first jotting in his field note-book runs:

> . . . Only knowing that Patagonia has been elevated 1500 feet above sea (& probably 300 feet below) Why not Tierra del Fuego? Cleavage stratification entering distant F Islands

There are in fact far more references to sea level change in the 1834 set of geological notes than those written during and following the 1833 fieldwork. In the year between the two visits Darwin had undertaken considerable exploration in Patagonia, where he had seen signs of regional uplift. Also, Darwin by 1834 had had the time and opportunity to read and think about Charles Lyell's ideas on sea level change. An entry on page 149 of the 1834 manuscript (DAR 32.2/149) seems to confirm this last point:

> Sub[merge] the land (according to Mr Lyell theory) 100 feet &

there is an efficient cause. – On this supposition the N.E. peninsula of the island would itself be an island.

As was so often the case, Darwin was unable to resist the temptation of comparison:

> A mass of land has been raised from the bottom of the sea (as in Patagonia in recent times). Since which its external form its internal bays, & its ridges of hills have been modelled on the principle of the hardest rock withstanding longest the effects of air and water.
>
> (DAR 32.2/146)

Notes in the margin at this point (possibly written later) confirm that Darwin was thinking on a regional scale: "Analogy from neighbouring continent connected with soundings".

But Darwin applied the same idea on a small scale too. He carefully examined coastal sections, and indeed drew at least one, showing peat overlying a fine white clay deposit. At one point he speculated that this clay might have been deposited when sea levels were higher, and there is just a suggestion that he though he had found what would now be called a raised beach, possibly near Estancia House:

> . . . In the N E Peninsula, found at some height above the sea a small flat plain with steepish sides which as it appeared had certainly once formed a bay.
>
> (DAR 32.2/149 Reverse)

In several places during his journeying aboard the *Beagle*, Darwin noticed shells high above a modern beach, and used this as an argument for sea-level change. He found no such evidence on East Falkland, but he quotes one reference in his notes to a whale bone being found by some earlier expedition well inland, north of the Sound, high above sea-level.

Although Darwin frequently commented on the long narrow inlets that cut into the Falklands landscape, he never once seemed to think of them as "drowned river valleys", as would a modern coastal geomorphologist, he was convinced, perhaps by his South American experiences that uplift of the land was the dominant influence.

Contemporary quaternary research has shown a considerable number of raised beaches in both West and East Falkland.[3] Thus both uplift and submergence have influenced the coasts of the archipelago within the last few thousand years. Darwin was therefore half right. But not for the only time in his scientific career he reached conclusions that were broadly correct at least partly on evidence that modern scientists would not regard as entirely satisfactory.

The fossils

From a very early point in his career, Darwin understood the importance of fossils. We have seen how he had been taught how to seek them by Professor Adam Sedgwick in North Wales during the summer before he left England. Between the visit to the Falklands in March 1833 and that of a year later, he had undertaken quite extensive work in the Pampas of South America, which had resulted in the unearthing of a number of fossil mammals new to science. These were later to be of the greatest importance in the development of his evolutionary ideas.

After a few days at Johnson Harbour in that March of 1833, Darwin seems to have been rather depressed and perhaps even a little bored. The island, he felt was "dreary"; one of his shipmates had been drowned; all around were signs of shipwreck; the weather was awful. On the 19 March 1833, for want of anything else to do he walked to the tiny settlement of Port Louis. He later wrote in his diary that his outlook on the Falkland Islands was forever changed after that walk; for he found a rock "abounding with shells; & those of the most interesting geological aera" (Fig 4.13).

Within a few days he was writing enthusiastically to his sister Caroline:

> I have been very successful in geology; as I have found a number of fossil shells, in the very oldest rocks, which ever have organic remains. – This <ha>s long been a great desideratum in geology, viz the comparison of animals of equally remote epocks at different stations in the globe.
> (Charles Darwin to Caroline Darwin, 30 March 1833: DAR 223. Part of the "has" has been lost.)

He went on the compare the apparent richness of the fossil fauna with the paucity of the living fauna of the contemporary bleak environment: "As for living creatures, these wretched climates are very unfavourable".

A little later he wrote excitedly to Professor Henslow, summarising points from his Geological Diary (several of the phases he uses echo those in his own notes):

> I had here the high good fortune, to find amongst primitive looking rocks, a bed of micaceous sandstone, abounding with Terebratula & its subgenera & Entrochitus. As this is so remote a locality from Europe I think the comparison of these impressions, with those of the oldest fossiliferous rocks of Europe will be preeminently interesting. Of course there are only models & casts; but many of these are very perfect. I hope sufficiently so to identify species. – As I consider myself your pupil, nothing gives me more pleasure than telling you my good luck.
> (Charles Darwin to John Stevens Henslow; 11 April 1833: Royal Botanic Gardens, Kew)

We can imagine the excitement of the aspiring geologist as he scribbled in his little leather-bound note-book (1.14):

> Slate . . . much laminated
> fossiliferous dipping N ½ E < 65° from
> this to vertical
>
> Slaty sandstone abounding with fossils
> dipping <14° to W by S: layers of shells
> in seams of hard conchoidal slate
>
> Shells parallel to seams of slate & strata
> covered above & beneath by vertical plates
> of slate dipping N ½ E; Cleavage of
> slate same above & beneath nearly
> vertical: Sandstone bed about 4 feet thick

After his initial inspection, Darwin returned a few days later (probably on 21 March) and spent a considerable time collecting fossils: several dozen specimens were obtained. He described them in some detail in his Geological Diary. After describing the highly cleaved slates that characterise much of the Falklands as

"belonging to that class which does not bear the signs of the coexistence of living beings with its formation", he went on:

> I was therefore the more surprised to find near the Settlement [to find *del*] within the Slate; beds of [slaty *del*] sandstone which abounded with impressions & casts of shells – The Sandstone is fine grained & soft: it is often slaty, in which case it generally contains scales of Mica: the whole rock is banded with narrow stripes (or slight alterations in colour.) which are parallel to the planes of stratification. – The included organic remains are found in seams or beds between the Sandstone strata. in some case[s] the casts form the whole mass, in others they are imbedded in Sandstone, & very often in a matrix of hard blue compact rock. – The shells all belong to terebratula & its subgenera; there are also different species of Entrochitus & [some *del*] vestiges of some other remains the nature of which I could not ascertain. – The beds of sandstone vary in thickness from two or three inches to as many feet: in one place there was an extensive bed of about of about 12 feet thick: almost universally they are covered above and below by the highly inclined lamina of Slate. –
>
> (DAR 32.2/125-126)

The budding palaeontologist shows that he understood well enough the general nature of fossils, and how they are formed, but some aspects nevertheless puzzled him:

> I applied Acid to the casts of the shells, but did not perceive any effervescence; it is a curious subject of investigation to know what has become of the Carb: of Lime. – From the state of preservation in which the striae & processes about the hinges are in; they must have been involved in their stony matrix, in their position of growth & probably when alive: What we now see, is the internal model or cast, & the impression of the outer parts of the shell, but the body of the shell itself seems to have been removed; we must however suppose it to have been present untill [sic] the surrounding mineral was consolidated; & then did the [shell *del*] constituent parts of the shell escape? – & where did they go to? -

Darwin was also puzzled that the fossils occurred in such abundance in the sandstone layer, but were so rare in the laminated slates above and below them. He wondered whether the fossils could have originally been present in the slates, but destroyed during their transformation.

But he clearly understood the importance of his find:

> I think this one of the oldest (or most inferior) formations which ever was fossiliferous. – The general character of the organic remains would also lead to this conclusion; it will be most preeminently interesting to compare these fossils with those of a similar epoch in Europe: to compare how far the actual species agree & the comparative number of individuals of each sort. –
>
> (DAR 32.2/125 Reverse)

Darwin's comparative approach reveals itself in a desire to know how these fossils compared with fossils of a similar age from elsewhere. Did fossils from different parts of the world resemble one another more closely far back in time that closer to the present as some palaeontologists had suggested? Or had remote areas of the world been biologically differentiated for long periods? Darwin was certainly not able to answer these questions with any degree of certainty aboard the *Beagle*, but later, after discussing his South American fossil mammals with Richard Owen, be became convinced of the validity of "law of succession of types", and was impressed by a "wonderful relationship in the same continent between the dead and the living". The fossil mammals of South America closely resembled the living forms, just as the fossil marsupials from caves in Australia resembled the kangaroos and wallabies that were to be found living in nearby bushland. That Darwin was thinking, albeit very vaguely, along these lines as early as March 1833 is most interesting. The suggestion that palaeontology might have a quantitative component was also far ahead of its time. Darwin's comments on the probable age of the deposit are also substantially correct: by "most inferior" he means lowest in the statigraphical column. The rocks of the Port Louis area are today assigned to the Port Philomel and Fox Bay Beds, described as "middle Devonian to late lower Devonian".[4] Fossils are of course to be found in older rocks, although they are in most places far from abundant below the Silurian. He identified the major

group to which most of the fossils belonged accurately and his assignment to particular genera was fairly shrewd. Bearing in mind the remote location in which he was working, the fact that he did not have reference works available to him to enable him to identify them fully (and in any event southern hemisphere palaeontology was in its infancy), he did pretty well.

We have already noted Darwin's remark on the comparative richness of the ancient fauna of the Falklands, in comparison with the islands' current poverty and bleak aspect. Even more explicit is the comparison made between the present climate and that of the remote past in a note added to the post–1834 manuscript:

> Do not the Entrochitus & other organic remains indicate a climate previously warmer? Where the latitude of the place is 51 degrees in the southern hemisphere is considered even a remote possibility on such a point becomes interesting. –
>
> (DAR 33/167 Reverse)

Yet again, in thinking about climatic change on such a scale, and envisaging a warm climate in the Falklands area, Darwin's speculations were far ahead of his time.

The fossils were eventually handed over to two Geological Society colleagues – John Morris and Daniel Sharpe. On the basis of Darwin's Falklands specimens, these gentlemen described eight new species of brachiopod (eg *Chonetes Falklandica* and *Spirifer antarcticus*), as well as identifying an *Orbicula*, an *Avicula*, some stem fragments of a crinoid (or sea lily), and finding some pieces of an unidentified trilobile. Morris and Sharpe were cautious when it came to assigning the fossils to a geological period, and in comparing them to fossils from elsewhere.

Some of the specimens bore "some resemblance" to Devonian forms, others to those of Silurian age. They went on:

> Thus we cannot attempt to place the beds in the Falkland Islands which have supplied these specimens, on the level of any particular portion of the European scale of formations, but must be contented with saying that they belong to a part of the palaeozoic series of which the position is still undetermined.
>
> (*Proc. Geol. Soc.*, 25 March 1846; vol 2 (Part i), page 277.)

There were some similarities to brachiopods from Van Diemen's Land, Southern Australia, the Americas and the Eifel district in

Germany, but Morris and Sharpe felt:

> The number of species collected by Mr. Darwin from the Falkland Islands is too limited to justify any close comparison with the palaeozoic fauna of other portions of the globe. . .
> (*Proc. Geol. Soc.*, 25 March 1846; vol 2 (Part i), page 277.)

One cannot help feeling that Darwin may have been just a tiny bit disappointed by his colleagues' ambivalence. Despite it, however, he felt that the Falklands fossils were sufficiently different from those elsewhere for the notion that in the more remote past organisms were much more widely distributed than are living creatures was in error.

> I conceive that the opinion, that the further we look back in time, the more widely distributed the same species of shells were, must be greatly modified. . .
> (*Proc. Geol. Soc.*, 25 March 1846; vol 2 (Part i), page 268.)

Darwin does not mention his ideas on the "law of the succession of types" (*see above, page* 88) in his 1846 paper on the geology of the Falkland Islands, but the above quotation confirms that he was thinking along the lines of that concept at the time he wrote it. The passage was almost certainly written, it should be remembered, after Darwin's alleged "conversion" in 1837, his writing of the "Sketch of 1842" and the "Essay of 1844". By March 1846, although *On the Origin of Species* still lay over 13 years in the future, Darwin knew that he was well on the road. Amongst the rocks on that road lay those that contained the "fossil shells" that were found in the sandstones around the Careenage, the little enclosed bay close to Port Louis, in 1833.

Catastrophism or uniformitarianism?

In his descriptions of the metamorphism and tectonics of the island, his accounts of the "streams of stones" and their possible origin, his speculations about changes in sea level and in climate, Darwin was clearly aware that the Falklands constituted a dynamic, changing environment. But was he a catastrophist or a uniformitarian at the time of his 1833 and 1834 visits to the Falklands? Did he believe that the history of the earth was largely

to be understood in terms of a series of occasional dramatic changes – earthquakes and floods, for example? Or was he on the way to becoming the "gradualist" that wrote of the development of coral atolls as the result of a sequence of changes, that applied developmental ideas to infant psychology, wrote of the transmutability of species through natural selection in *On the Origin of Species*, and, towards the end of his life, the substantial effects that the tiny changes brought about by earthworms could have over long periods of time?

One of the books to which Darwin had access aboard the *Beagle* was A J Pernety's *Histoire d'un Voyage aux l'Isles Malouines*, an account of Bourganville's voyage to the Falklands, published in Paris in 1770. Darwin makes a number of references to this work in his notes: there must have been occasions when it was open on the "great table" in the poop cabin alongside his specimens, as he wrote his Geological Diary. Chapter xviii of volume 2 of this book is entitled *Singularité de la nature qu'on observe dans un endoit ses Isles Malouines* (An oddity of nature seen at a place in the Falkland Islands). This short essay describes in the most extravagant terms the rock exposures with their contorted strata and the stone-runs of the area near Port Louis. The anticline and the amphitheatre nearby, are compared with a ruined city with broken gates and arches: phrases such as "un superbe tableau de ruines" (a superb scene of ruins) litter the account. The landscape represented a "horribly beautiful" spectacle – "terriblement beau".

> Nous n'avons pas été moins saisis d'étonnement à la vûe d'innombrable quantitité de pierres de toutes grandeurs, bouleversées les unes sur les autres, & cependant rangées, comme si elles avoient été amoncelées négligiemment pour remplir des ravins. On ne se lassoit pas d'admirer les effets prodigieux de la nature.
>
> (We were not less startled by the view of a vast quantity of stones of all sizes, thrown into confusion, one on another, and yet arranged as if they had been piled up negligently to fill the valleys. We didn't cease to admire nature's prodigious effects.)

The above section is marked in Darwin's copy or Pernety's book, now preserved in Cambridge. Fig 4.14 shows Pernety's illustration of the breached dome, and Fig 4.15, the scene as it appeared in 1989. Compare these illustrations with the sketches that appeared in Darwin's notes, Fig 4.6.

Equally vivid is Pernety's description of stone-runs:"des especes de ravins absolument comblés de ces pierres bouleversées." The translation (a kind of valley quite full of overturned stones) loses something.

Without being too specific, an origin involving earthquakes is hinted at: "un boulversement produit, selon les apparences, par quelque tremblement de terre" (an upheaval produced, it seems, by some earthquake).

Darwin actually refers to this section in his geological notes. Further, many of the comparisons in Pernety's account, with ruined buildings abandoned cities, and so on, have echoes in Darwin's notes on the locality. A couple of examples must suffice:

> Great masses of these [strata] being much fractured & torn, often show resemblances to walls & ancient buildings.
>
> (DAR 33/191)

> . . . there also the curved strata of archways lie piled over each other like the ruins of some vast & ancient cathedral. But I feel quite at a loss when I attempt to draw these scenes of violence & desolation.
>
> (DAR 33/205)

At one place in his notes (DAR 33/1821–182), where Darwin is describing the broken anticline, he includes a marginal annotation: "Hill of ruins of Pernetty?".

Catastrophism – the idea that the earth's features are primarily the result of sudden dramatic events rather than the products of gradual changes – is a strand that has run through geological thought for centuries. It was an idea that lay well with some fundamentalist notions – that the book of *Genesis* in the Old Testament, with its account of the Creation and the Flood represented an accurate description of the early stages of the earth's history. The young Darwin would have been familiar with these ideas, and it seems quite possible than reading Pernety's account of the "horrible beauty" of the jumbled masses of the stone runs and the contorted strata exposed in the hillsides, the images of ruined cities and mentions of earthquakes influenced him, in the language of his account of the landforms and geological structures of the area north of Berkeley Sound. It is but a simple step to argue that *some* of his catastophic interpretations can be at least partly attributed to the same source.

Darwin wrote of:

> The summit of hills where generally these curved strata present a scene of great violence; they are covered by great blocks & dislocated by fissures . . . Everywhere the quartz rock has been violently shaken . . . .
>
> (DAR 32.2/140)

The anticlinal ridge or dome Darwin refers to again and again by some term such as the "line of upheaval", and stone-runs could be traced to the crests of hills

> where masses as large as churches have been arrested in their course; the curved plates of the arch-ways lie in the immense quantities at the very source; the scene is like a ruined castle, which formerly commanded the pass.
>
> (DAR 32.2/147)

On the reverse of the same sheet of notes is the following:

> On a hill 700 feet high at the very summit I saw a large arched fragment, lying on its convex surface. – Therefore the piece must have been pitched up & turned or more probably another part of the hill antrior to these convulsions was higher than at present.

A page or so later Darwin wrote:

> How immense must be the force have been which could have caused great angular blocks to have flowed like a liquid down very gentle inclinations, probably when above the water. The convulsions to which these facts are to be attributed, must chiefly have taken place since the elevation of the land. – The blocks are angular, with only their points blunted (caused by their fall).
>
> One would suspect that the tops of hills had been (subsequent to their consolidation) blown up like the walls of a castle with gunpowder. –
>
> (DAR 32.2/148 and 148 Rev)

But although Darwin may have got some of his "cataclysmic" language and his imagery from Pernety's book on the *Isles Malouines* (the word is the origin of the name "Malvinas" used in Argentina and by other South Americans for the Falklands), he

was quite capable of putting together a theory to explain the folding, and a good deal more besides.

> Arguing then on the Plutonian theory, as the strata, now in view have formerly been rendered semi-fluid by the action of heat proceeding from the more central parts of the globe, so we must believe, that at some depth beneath the surface, the matter was more perfectly liquid: And when we see the present hard strata imitating the undulations of a great swell, we are driven to suspect "that the propelling power had actually moved in the form of certain great waves." Moreover, as in many of the hills (the height of some, being little short of 1000 ft), the strata all belong to one system of curvature, the propelling wave must have been of nearly similar dimensions. I do not at all state this fact as proved, but it is a strong presumptive argument in favor [sic] of paroxysmal movement; in mountains where the strata have been fractured, this inference cannot with any certainty be drawn. A solid arch alone bespeaks unity of time in its construction. With respect to the smaller curvatures, especially where they occur on the flanks of higher hills, probably they have in the greater number of instances, been caused by lateral pressure, doubling the pliant state, as when the two ends of a book, or bundle of paper are pressed together with force . . .
> (DAR 33/198–199)

The "Plutonian theory" (line one of the above quotation) was that which attributes many geological phenomena to the action of the internal heat of the earth. The debate between the "Plutonists" and the "Neptunists", those that sought an aqueous origin for many rocks (including many of what would now be identified as igneous rocks) was an important theme in late eighteenth and early nineteenth century geology. The debate was virtually brought to an end in about 1830 with the publication of Lyell's *Principles of Geology*, a copy of which, as we have already seen, Charles Darwin had aboard HMS *Beagle*.

But some of Darwin's writings, never intended for anyone but himself, were even more wildly speculative, and he knew it.

> It is important to observe, that the power which causes cleavage is so far of a mechanical nature, as to bend & stretch the strata of Quartz. – Is it Vibration?? – Are the lines of mineral change

owing to lines of Electrical intensity, or differences?? & therefore of heat? !!??-

There is no harm in conjecture – do the Electrical currents which circulate at the surface & are supposed to cause polarity act with such intensity beneath the surface and melt & alter rocks? !!!!!! ***

(DAR 32.2/146 and Reverse; punctuation as in original)

In fact these "conjectures" were perhaps not quite as wild as they might have seemed!

Darwin's notes show in more than one place that he asked gauchos who had lived in the Falklands a number of years whether the islands were ever affected by earthquakes: he must have been a little disappointed when they replied in the negative. But this did not discourage him. Darwin knew of the reputed volcanic activity of certain Antarctic and peri-antarctic islands, and there are several scribbled marginal notes about this. He seems to have wondered whether there might have been a connection between the presumed earthquakes responsible for the Falklands landforms, and these centres:

The Volcanic focus of these earthquakes may perhaps be connected with the Antarctic islands.

The unfortunate Brisbane (*see page* 22 and 37) seems to have given Darwin a good deal of information on this matter, during the *Beagle*'s first visit to the islands in 1833:

Information from Capt. Brisbane. South Desolation said to be volcanic with hot springs. – All the South Shetland [Islands] with hot springs & vesicular lava. Also Captain Weddell saw smoke issuing from rock. – South Orkneys volcanic products.

(DAR 32.2/122)

South Desolation Island undoubtedly refers to Deception Island, which was known as Desolation Island among British sealers in the 1820s. Brisbane visited Deception with Captain James Weddell in 1823. That expedition did indeed see "smoke" issuing from Bridgeman Island. And the description of Deception Island (an island in the South Shetlands that consists of a partially submerged volcanic crater with many hot springs, patches where the ground is quite warm, and which was active last in an eruption

in 1967) is entirely accurate. Weddell, incidentally, in his account of the voyage stated that he "had full confidence in the care and ability of Mr Brisbane".[5] "Georgia" (ie South Georgia) is also mentioned by Darwin in a similar context in his notes. (Fig 4.16 shows the locations of the sites discussed by Brisbane and Darwin in 1833, and mentioned in Darwin's geological notes.)

Most of these "conjectures" were never published by Darwin. Apart from the suggestion that the stone-runs might have an earthquake origin, mentioned in *The Voyage of the Beagle*, the more extreme catasrophic ideas, the imagery of ruined cities, broken arches and castles being blown up by gunpower never saw the light of day during his lifetime.

For Darwin was already falling under the influence of Lyell, and references to *Principles of Geology* also litter Darwin's geological notes, including those of the Falklands. Lyell's book, the first volume of which Darwin had with him on leaving England (ironically given to him by fundamentalist FitzRoy), preached the doctrine of uniformitarianism, of the evolution of the earth through the processes of gradual change, processes that can be observed to be going on around us today. And in Darwin's accounts of the Falklands, as well as the catastrophist ideas discussed above, one can detect images of streams gradually wearing away uplands, peat imperceptibly spreading over the land, the sea crumbling away the coast, and deposition, little by little, infilling water bodies:

> Subsequent degradation (which I believe in this land has taken present [sic] to a great extent) would remove most cases of direct superposition . . .
>
> (DAR 33/197)

> No map exists which pretends to follow all the windings of the many creeks amongst the islands: if there did, it would almost represent a Medusa's head. . . They are generally shallow & silted up with much mud, their heads being converted to dry land: the water is so still & motionless that it does not carry along decomposing matter.
>
> (DAR 32.2/148)

> I believe the Peat to be formed very slowly from the grass & other plants now growing on the surface.
>
> (March 1834; DAR 32.2/134 Rev)

And of the stream he heard "tinkling" beneath the stone run (probably Prince's Street) he wrote:

> . . . the water of small streamlets could be heard, many feet below trickling through the stones . . . the crevices between the lower fragments must have been filled up with sand, & the bed of the rivulet raised.
>
> (DAR 33/204)

Not so many perhaps, as the pictures of the land being violently shaken, and rocks being deformed by strange waves deep within the earth, but this is hardly surprising. The third volume of *Principles* seems only to have reached Darwin after the Falklands visits, and Darwin had not yet been fully converted to *gradualism* – the key idea that went through much of Darwin's work from the coral atoll theory onwards. There do seem to be rather more uniformitarian allusions in 1834 documents than 1833, but to be fair some of the most extreme catastrophic statements were also written in 1834. The bulk of the Falklands Geological Notes thus come from a time when both the more traditional ideas, and the newer Lyellian concepts were having an influence on Darwin's thinking: a conjunction that can be symbolised by Volume I of the *Principles of Geology* and Volume II of Pernety's *Histoire d'un Voyage aux Isles Malouines* lying open together on the poop cabin table amongst Darwin's notes, instruments and specimens.

Near-vertical plates of quartzite, Main Range, East Falkalnd. Photograph: Patrick Armstrong

Chapter 5

Understanding the Living pattern

Darwin's approach to scientific work at the time of the Falklands visits

Although John Henslow had told him, before he left on the *Beagle* voyage, that he was "an unfinished naturalist", Darwin was nevertheless an enthusiastic one. The days of beetle-collecting as a Shropshire lad, and of botanising as he "walked with Henslow" in the River Cam valley had made the young Darwin a competent collector and careful observer of the natural world. Although geology took much of his energies while the ship was in Berkeley Sound in those autumn days of 1833 and 1834, Darwin made a substantial collection of plants, fish, insects, shells and accumulated a large number of bird skins. He made detailed comments on many of his natural history specimens, and also recorded many other observations on plants and animals in his notebooks. And although his "conversion" to an evolutionary point of view still lay years in the future, his training at the feet of men of the cut of Henslow and Sedgwick, and his reading of Herschel's *Preliminary Discourse on Natural Philosophy*, meant that far from simply accumulating specimens and observations, Darwin, even at this early stage, was beginning to order them around certain ideas. He was constantly comparing his observations in one locality with those he had made elsewhere, and with those of others. It was this comparative approach (see chapter 1) that later helped him adduce generalisations or "laws" concerning the living world. A careful analysis of some of the writings made by Darwin as the little ship lay in Berkeley Sound shows traces of concepts and approaches that were to be of importance to him in his later work.

Yet Frank Sulloway has suggested,[1] on the basis of a careful content analysis some of Darwin's personal letters, that his morale was at a lower point during the period of November 1832 – April 1833 than at any other time during the voyage. His dislike of ships and the sea was making itself felt, and he had little idea of whether his programme of collecting and observation would be well received by the scientific community; but as he received feedback from

Henslow on his specimens, and as geology progressively increased in importance over other branches of natural history, his self-confidence steadily improved. There is certainly a touch of melancholia about some of Darwin's Falklands annotations, partly perhaps induced by the dreariness of the environment, the dreadful weather, and the atmosphere of decay, death and shipwreck that pervaded the scene on the occasions of both visits. Yet many of Darwin's observations were as sharp as any he made anywhere. Let us now see how the ship's naturalist saw the living Falklands environment, subjected as he was to this mix of conflicting psychological pressures, attitudes and emotions.

The whole community

Darwin's notes on the organisms of the Falklands, as with those from other parts of the voyage, frequently contain comments concerning a creature's habitat, and brief notes on the relationships between different species. A species of holothurian was "not uncommon under stones". A "Creusia" was encountered (on 15 March 1833) "a little below high water mark in a stream of fresh water . . . this genus is especially fitted for brackish water & for a certain time even in fresh", Darwin noted. A "coralline" was described which "most abundantly coat[s] the rocks" or occurred "growing on itself" and forming "bosses". The habitats of other species of invertebrates were described as "among the roots or growing on the fronds of the giant Kelp" (DAR 30.2/159–165). A fish specimen was described as having been found living "beneath stones". The Falklands thrush (*Turdus falcklandii*) Darwin described as "inhabiting the dryer and more stony hills . . . the sea coast, . . . and also not uncommon around buildings, especially any old shed" (DAR 29.2/33). (I am pleased to say that I found thrushes "around any old shed" at Port Louis when I visited that settlement in 1989.) Darwin also cut open birds to ascertain upon what they fed, and noted what living birds were observed eating (DAR 29.2/33). He noted that one of his shipmates had shot a steamer duck (*see page* 105), and besides recording its weight (6lbs) he noted that a crab and a shell fish had been found inside it. He saw a certain poetry in these relationships and phrases such as "beautiful adaptation" and "economy of nature" litter his notes.

But Charles Darwin's integrative powers went further than the

Figure 5.1. Kelp bed, Berkeley Sound, East Falkland. Photograph: Patrick Armstrong.

noting of one-to-one ecological linkages. He appreciated the integrity of the whole environment, and the way in which complex networks of relationships existed. After spending some time examining the creatures of the kelp bed communities (Fig 5.1) of Berkeley Sound, East Falkland, drawing in material from his similar researches in Tierra del Fuego he wrote, in April 1834:

> E. Falkland Isd.
>
> The Zoology of the Sea is I believe generally the same here as in Tierra del Fuego: Its main striking feature is the immense quantity & number of kinds of organic beings which are intimately connected with the Kelp.[2] – The plant (the Fucus giganteus of Solander) is universally attached to rocks, from those which are awash at low water & those being in fathom water: it is frequently attached to round stones lying in mud. From the degree to which these southern lands are intersected by water & the depth in which Kelp grows the quantity may well be imagined, but not to a greater degree than it exists. – I can only compare these giant forests to terrestrial ones in the most teeming part of the Tropics; yet if the latter in any country

were to be destroyed, I do not believe nearly the same number of animals (a) would perish, as would happen in the case of Kelp: All the fishing quadrupeds & birds (& man) haunt the beds attracted by the infinite number of small fish which live amongst the leaves: (the kinds are not so very numerous, my specimens I believe show nearly all.) – Amongst the invertebrates I will mention them in order of their importance. Crustacea of every order swarm, my collection gives no idea of them, especially the minute sorts. – Encrusting Corallines & Aztias are excessively numerous. Every leaf (excepting those on the surface,) is white with such Corallines or Corallines & Spiroba & compound Ascidia. Examining these with strong microscope minute crustacea will be seen. – (b) The number of compound & simple Ascidia is a very observable fact. – as in a lesser degree are the Holuthuria & Asterias. – On shaking the great entangled roots it is curious to see the heap of fish, shells, crabs, sea-eggs, cuttlefish, star fish, Planaria, Nercilæ which fall out. – This latter tribe I have much neglected. – Amongst the Gasteropoda [sic], Heurobranchus is common: but Trochus & petalliform shells abound on all the leaves. – One single plant forms an immense and most interesting menagerie. – If this Fucus was to cease living: with it would go many of the Seals, the Cormorants & certainly the small fish & sooner or later the Fuegan Man must follow. – the greater number of invertebrates would likewise perish, but how many it is hard to conjecture.

(DAR 31.1/242–243)

Notes on the back of the page refer to small letters inserted into the text, probably later:

(a) I refer to numbers of individuals as well as kinds
(b) The number of Corallines inarticulate encrusting & coating rocks and shells both in and *out* of Tidal influence is very observable. –

There are a number of sophisticated ecological concepts expressed and implied in this passage. Darwin is comparing the *productivity* of the Kelp beds on the margins of the Southern Ocean to that of the tropical rain forests, distinguishing carefully between *population size* (number of individuals) and *species diversity* (number of species). He comes close to using the concepts of *food-chain, food web, ecological niche* and *dominant*

species, although of course these actual terms were not coined until nearly a century later. He appreciates that there are links between microscopic and macroscopic forms, and also, very clearly, that humans are linked to their environment. The passage represents a truly integrated and holistic viewpoint, and a striking one for a young observer with almost no formal training in science, and some six decades before the term *ecology* was introduced.

A slightly later passage shows how early Darwin appreciated the tangled web of relationships between the living and non-living components of the environment:

> The motion of the sea seems necessary to the life of its productions: this island is much intersected by water (Capt FitzRoy has compared it it the arms of a Cuttlefish). These far inland seas are nearly motionless, they seem to produce hardly any organic beings. Creusia occasionally encrust the rocks, even where streams enter. The grebe (1917) proves that some few small fish are present: the water instead of cherishing the elegant forms of corallines, throws up a putrid mass of rubbish – The powers however of Geology are quickly covering these unproductive specks on this our globe. –
>
> (DAR 31.1/243)

Plants and animals, land and ocean, fresh and salt water, rocky shore and pile of decomposing sea-weed are seen as linked components. Moreover the picture is a dynamic one – a distinction is made between moving and motionless waters, and allusion is made to both the processes of the decomposition of organic matter and sedimentation.

The above sets of notes were written very soon after the field experiences to which they relate, probably during the passage between Berkeley Sound and the mainland of South America. Although the style is somewhat ragged and abbreviated in character, there is a spontaneity and liveliness about the passages that reflects the young Darwin's enthusiasm: he was prepared to allow his *feelings* about an environment to shine through his observational detail.[3]

Animal behaviour and instinct

Darwin's powers of careful observation were exercised throughout

the long years on the *Beagle* on the *behaviour* of animals, as well as their morphology and appearance, these being the much more usual concerns of naturalists of the day. The notes that he made in the field in the "little notebooks" are usually exceedingly abbreviated: this is hardly surprising considering the conditions under which he was working – phases such as "hail & wind" and "snow & wind" alternate with somewhat cryptic geological or ornithological annotations. Yet behavioural observations are often quite detailed:

> Saw a Cormorant catch a fish and let it go 8 times successively like a cat does a mouse or otter a fish: & extreme boldness of shags.
>
> (Notebook 1.14; March 21, 1833)

As always Darwin is using the comparative technique: in this case he is comparing the habits of one animal with those of others.

Darwin's description of the habits of the Jackass (or Magellanic) penguin (*Spheniscus magellanicus* [see Fig 3.1]) in his *Zoological Diary* is particularly detailed and perceptive:

> I was much amused by watching a Demersa, having got between the water and it. – It continually rolls its head from side to side (as if could only see with [only the?] anterior portion of [its?] eye). Stands quite upright: can run very fast with its head stretched out & crawls amongst the tussocks by aid of its little wings so as to extraordinarily resemble a quadruped: throws its head back & makes a noise very like a Jackass, hence its name: but when at sea & undisturbed its note is very deep and solemn, often heard at night. – When diving (can do so in very shoal water) uses its wings very rapidly and looks like a small seal. From its low figure & easy motion looks crafty like a smuggler. – Is very brave, regularly fought & drove me back till it reached the sea. – nothing less than heavy blows would have stopped: every inch he gained he kept, standing close before me erect and determined. –
>
> (*Zoological Diary*, DAR 31.1/240)

Of the Caracara (*Phalcobœnus australis*; Darwin in his notes uses the name *Caracara Novae Zelandiæ*):

> . . . They build in the cliffs on sea coast, but only in the islands an odd precaution in such very tame birds. – They are excessively numerous in these islands . . . They are true carrion

feeders, following a party & rapidly congregating when an animal is killed; are extremely tame, especially when gorged with their crops protruding. In general habits much resemble the Carrancha; same inelegant flight & patient watching position: they however run much faster, like poultry . . . They have several harsh crys; one very like an English rook; when making this, they throw their heads quite backwards on their back. – are very quarrelsome, tearing the grass with their passion . . .

(March 1834, *Zoological Diary*, DAR 31.1/238–239)

Although the accounts are a little anthropomorphic, the young naturalist comes close, in some places, to *analysing* the behaviour patterns, for example in noting the aggressive behaviour of the penguin, and describing the grass-tearing action of the caracara as a display of "passion": a modern ethologist might use the term "displacement activity". Again we note the comparative treatment. The modern observer can hardly fail to be impressed by the level of detail and vividness of the descriptions. Such careful accounts of the postures, calls and locomotion (gait, flight patterns) were relatively unusual in Darwin's day.

The suggestion that behaviour should have been used as a basis for classification in the 1830s would have been something of an innovation, but in several places he seems to have been grasping in that direction. Darwin is still referring to the caracaras:

Mr Mellersch having wounded a cormorant it went on shore & immediately these birds [caracaras] attacked & by blows tried to kill it. – Connection in habit as well as structure with true Hawkes. –

(DAR 31.1/238 Rev)

His account of the flightless steamer duck (modern scientific name *Tachyeres brachydactyla*) is in some respects similar:

1834 April E Falkland Isl[d].

A logger-headed duck called by former navigators [a now *del*] race-horses, & now steamers has been described from its extraordinary manner of splashing & paddling along: they here abound; in large flocks; In the evening when preening themselves make the very same mixture of noises which bull-frogs do in the Tropics: their head is remarkably strong

(my big geological hammer can hardly break it) & their beak likewise; this must fit them well for their mode of subsistence: which from their dung must chiefly be shell-fish obtained at low water & from kelp – They can dive but little, are very tenacious to life, so as to be (as all our sportsman have experienced) very difficult to kill; They build amongst bushes & grass near the sea. –

The account mentions many aspects of behaviour. But there is a bit more to the description than a natural theologian's account of "exquisite adaptation" to which some notes on voice, nesting and locomotion have been appended. Here is an attempt, imperfect perhaps, but nevertheless ahead of its day, to show how an organism "slotted into" its habitat, and an understanding that behaviour, food, habitat and structure were related to one another: the heavy head and bill "fit them well for their mode of subsistence"; the ducks seldom dive but feed from "shell fish obtained at low water & from kelp". They are strongly social, and "abound in large flocks"; they are thus very vocal, with a vigorous "splashing" display. Darwin does not directly link their seashore (rather than inland) nesting to their lack of capacity for flight, or suggest that their tenacity to life might be a compensation for flightlessness, but there does seem to be an integrative pattern about the way in which Darwin noted down his observations.

The tameness of Falklands birds (and also of the "fox" or "warrah")[4] impressed Darwin: "It is common in every bird: geese, hawks, snipe . . . the thrush in flocks in the stony valleys surround a person within two or three feet of him." The modern visitor to the Falklands would agree with every word of this; compare the incident described on *page* 4. Darwin compared the extreme tameness of the birds in the Falklands with the situation in Tierra del Fuego, where "for *generations*" the birds "have been persecuted" by the inhabitants. He argued that many individuals there "must have seen as little or less of man" than in the Falklands and that the wildness must be hereditary (DAR 31.1/241–242). The appreciation that behavioural traits might be inherited, and might be affected by environment was indeed perceptive, and an interesting precursor of Darwin's later evolutionary views.[5]

Darwin also compared the tameness of the Falklands birds with that of those of the Galapagos, incorporating material from both archipelagoes in his *Beagle* accounts (DAR 29.2/78). These com-

parisons also appear in his *Natural Selection*[6] manuscript. Frequently phrases are transposed almost verbatim:

> *Instinctive fear.* I have already discussed the hereditary tameness of domestic animals: . . . I have no doubt that the fear of man has always first to be acquired in a state of nature, & that under domestication it only is lost again. In all the few archipelagoes & islands uninhabited by man, of which I have been able to find an early account, the native animals were entirely void of the fear of man:. . . Old Dom Pernety says that the Ducks and Geese at the Falkland Islands walked before them as if mad [sic; Pernety wrote 'privés' i.e. tame.] At the Galapagos Islands I pushed a hawk off a tree with the muzzle of my gun, & the little birds drank water out of a vessel which I held in my hand. . . . I will only remark here that the tameness is not general, but it is special towards man: for at the Falklands, the Geese build on the outlying islets on account of the foxes. These wolf-like foxes were here, as fearless of man, as were the birds. . . . The tameness of the birds at the Falklands is particularly interesting, because most of the very same species, more especially the larger birds, are excessively wild in Tierra del Fuego, where for generations they have been persecuted by savages. (Chapter X, "Mental powers and instincts of animals", pages 58–59).

It was not only the behaviour of the indigenous creatures of the Falklands that interested Darwin. In his Diary he noted that the feral horses went about in small groups or "troops". In his field note book in March 1833 he scribbled:

> Horses fond of catching cattle
> aberation of instinct

He was presumably referring to the remarkable way in which the gauchos were able to train their horses for capturing cattle, described in chapter three. The relationships amongst behaviour (particularly group behaviour), instinct and numbers of organisms seem to have been quite important and are discussed in more detail below.

Endemism, dispersal . . . and evolution?

A theme that runs through almost the entire corpus of Darwin's biological work is an interest in the distributions of animals and plants. The enquiry was conducted by the comparative method

(*see page* 7). From the scribbled jottings made in his note-books during the early months of the voyage of HMS *Beagle*, to the published works of the final year or two of his life one can find comparisons of the organisms of one locality with those of another, together with speculations as to the reasons for similarities and differences. Geographical distributions were to form an important theme in *On the Origin of Species*, and indeed two out of fourteen chapters of that work were devoted to the topic of distributions.

An important debate amongst scientists during the nineteenth century was on the relative importance of long distance dispersal and continental extension – the idea that the continents have been more extensive at some time in the geological past than at the present, and that lands now separated by great expanses of ocean were formerly connected.[7] Darwin also attached great importance to changes in sea level, believing that areas now beneath the sea might have once been dry land, as well as that in some places the sea might have lapped higher than today.

Yet at the same time he felt that long distance dispersal was important, appreciating that remote oceanic islands had been colonised through dispersal by wind, waves and through the carriage of spores, seeds and fruits etc by birds. In later life Darwin conducted a series of experiments on such topics as the powers of flotation of seeds and attempted to extract seeds from owl pellets: he was attempting to ascertain experimentally the extent to which plants might have been carried across the sea.

Although it is not easy either to read, or to interpret, one of Darwin's first annotations on the archipelago in one of his "little note-books" on the "plants and insects" of the islands, it seems to be a comment on the similarity of island forms with those on the mainland, and a "connection" greater than could be explained by migration.

A few previous writers (eg Grove, 1985)[8] have argued that these scribblings imply that from the very earliest days of Darwin's experience of the islands he was thinking in an evolutionary way. Much recent scholarship, on the other hand, has it that it was only in the very last few months of the voyage did any serious notion of the transmutability arise in Charles Darwin's mind, and that his complete "conversion" had to await his return to England – Sulloway suggested that March 1837 was the most likely moment.[9] It seems, therefore, most likely that Darwin was more

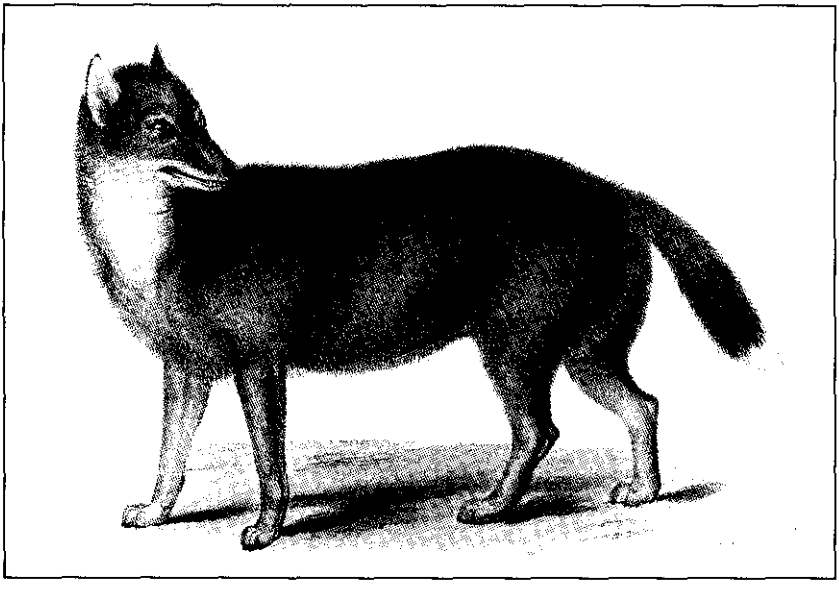


Figure 5.2. The extinct Falkland fox or warrah, from an illustration in *The Zoology of the Voyage of the Beagle*.

interested in collecting material for a possible contribution to a continental extension/dispersal debate, than that he was seriously entertaining evolutionary ideas in the southern hemisphere autumn in 1833.

Darwin had already spent several months on the mainland of South America and around Tierra del Fuego and his notes are replete with comparisons between these areas and the Falklands. A very few examples must suffice. After writing of "the individuality of a species" of the Falkland fox (Fig 5.2) which was called *Vulpes antarcticus*, or *Canis antarcticus* and now referred to by the scientific name *Dusicyon australis*, he went on:

> It is very curious, thus having a quadruped peculiar to so small a tract of country: The rat (1159) is also aboriginal: it is evidently become partly domesticated & attached to the houses.
>
> . . . The freshwater fish (which are found in inland lakes) & the number of common earthworms probably belong to the same class.
>
> (DAR 31.1/237; April 1834)

He frequently compared the birds of the South American mainland with those of the Falkland Islands: his *Ornithological Notes* contain a number of such references, and years later in his *Big Species Book*[10] he was to write:

> Some land birds are common to Tierra del Fuego, absolutely covered by impenetrable forests, & the Falkland Islands, where not a tree exists.
>
> (*Natural Selection*, chapter VIII, page 13)

Several times in his notes he recorded that there were no reptiles on the Falklands (Note book 1.8 and DAR 31.1/237 Rev). He also noted differences in the species, and relative abundance of plants: "Bog plants of Tierra del Fuego" were much less numerous in the Berkeley Sound area of the Falklands (Note-book 1.14; March 1833); he may have meant the pillow-like plant known to Falkland Islanders today as "Balsam-bog" (*Bolax gummifera*).[11]

But he was also on the look out for similarities:

> I may mention . . . as common to this island & Tierra del F . . . rush-looking plant, tea plant, celery.
>
> (DAR 31.1/237 Rev)

It is not clear what Darwin's "rush-looking" species might have been, possibly the native rush (*Juncus scheuchzerioides*); the tea plant was probably teaberry (*Myrteola nummularia*), and the celery, a local wild celery (*Apium australe*).

Darwin is thus noting that while there are important singularities about the Falklands Islands biota (the Fox, the freshwater fish, some invertebrates, some plants) there are also strong similarities with the mainland of South America and with Tierra del Fuego (other plants, insects, and several species of birds). Darwin, inexperienced although he is, is quite prepared to offer explanation:

> The plants and insects might easily be transported from Tiera del [Fuego] in the SW furious gales. –
>
> (DAR 31.1/237)

He considered dispersal by sea for some creatures, but with certain types of organisms he felt this route was unlikely:

> Earth worms, from salt water being so deadly a poison (hence

probably the eggs) is a difficult animal to account [for] by accidental transportation.

(DAR 31.1/237 Rev)

On the other hand, even while the young naturalist was still in the field, watching the geese feeding on the tussac, he appears to have speculated on the possibility that migrating birds might carry seeds from the mainland:

> Migrations of geese in Falkland Islnds as connection with Rio Negro.
>
> (Notebook 1.14, March 1833)

This despite the fact that his geological notes emphasise the shallowness of the seas between the Falklands and Argentina.

Although Darwin himself only visited East Falkland, he was in contact with a number of those, including the crew of the *Adventure*, Captain Brisbane, and Mr William Low, who had visited West Falkland and a number of the outlying islands on several occasions. Darwin sometimes notes difference between the biota of East and West Falkland, and also between these two large islands and some of the smaller islets. He recorded that the Caracara "build in the cliffs on the sea coasts but only on the islands"; Darwin thought this "an odd precaution in such very tame birds". Rats were also found on the outer islands, but not the fox. His note on the differences between the foxes of the two islands was ultimately to prove extremely important.

> Out of the four specimens of the Foxes on board, the three [larger ones *del*] are darker and come from the East; there is a smaller & rusty coloured one which comes from West Island; Lowe states that all from this island are smaller & of this shade of colour. -
>
> (DAR 31.1/237 Rev)

Darwin's tentative conclusions, after the 1833 and 1834 visits (although he did not organise them in such a definite form) seem to have been:

1. There are some organisms that are apparently unique to the Falklands, and some that occur both in the archipelago and in South America.
2. Long distance dispersal by wind or by birds provides a possible

mechanism for some of the similarities.
3. There also seem to be some differences between the various islands of the archipelago.

However, nowhere in his writings made during the Falklands stays, or immediately afterwards, does there appear an unequivocal evolutionary statement.

Partly through his habit of rewriting his notes from time to time, incorporating new material (*see page* 8), Darwin constantly had cause to review his material from early in the voyage much later. The Falklands visits were followed by extended explorations in southern Chile and the Andes, and visits to Australia and a number of islands of the Indo-Pacific, such as New Zealand, the Galapagos, Tahiti, Cocos and Mauritius. There is some slight evidence that Darwin, after these experiences, was more open to ideas of transmutability. Some notes now dated by Sulloway at about June 1836, while Darwin was thinking mainly about the Galapagos, contain the words:

> When I see these Islands in sight of each other, & [but *del*] possessed of but a scanty stock of animals, tenanted by these birds, but slightly differing in structure & filling the same place in Nature, I must suspect they are only varieties. The only fact of a similar kind of which I am aware, is the constantly asserted difference – between the wolf-like Fox of East & West Falkland Islds. – If there is the slightest foundation for these remarks the zoology of Archipelagoes – will be worth examining: for such facts would undermine the stability of Species.

Even as he wrote this Darwin was not yet a *convinced* evolutionist. But by the end of the voyage, Charles Darwin seems to have been entertaining the *possibility of instability*, a possibility raised, but only to be immediately dismissed by Charles Lyell in *Principles of Geology* (Vol II, pp174, 179), a copy of which, as we have seen, Darwin had with him. As the *Beagle* skimmed her way northwards the length of the Atlantic towards the end of the voyage, and Charles thought over the material he had garnered from the Galapagos, the Falklands and the other island groups visited during the voyage, the similarity of some aspects of the natural history of these archipelagoes seems to have occurred to him.

The true "conversion" was not to occur, according to Sulloway,

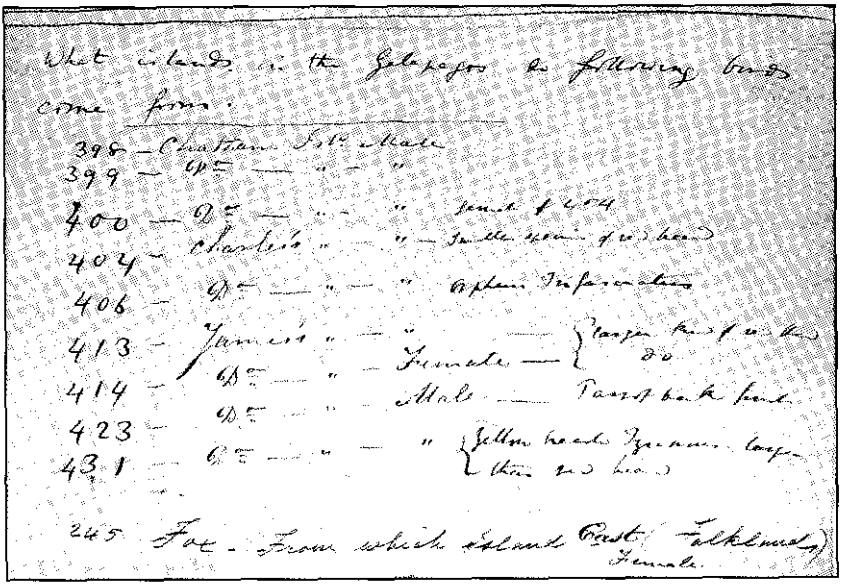


Figure 5.3. Notes, partly in Darwin's hand, and partly in those of his assistants, on the birds of the Galapagos and on the Falklands fox. For details see text. Photograph: Cambridge University Library.

until the week of about 7–12 March 1837. It seems to have followed discussions with Owen on some of the fossils he had brought back from South America, and with Gould on some of his Galapagos bird specimens. As the result of these discussions with Gould, Darwin appreciated what a serious lapse had been his failure to identify the exact island from which his various Galapagos specimens had come. Frank Sulloway (1984) suggests:

> Darwin subsequently sought to rectify his failure to label his own Galapagos finch specimens by island, by collecting every scrap of available locality information from the accurately labelled collections of three other *Beagle* shipmates, including that of his own servant [Syms Covington].

He wrote one request for information on a scrap of paper still held in the Darwin Archives at Cambridge (see Figure 5.3), on which an amanuensis or secretary wrote replies. In the hand of a different person (apparently unidentified, but known to have worked for Darwin after the voyage) is the following note beneath the list of Galapagos birds:

245 Fox – From which island [?]
This query is answered in the hand of the first amanuensis, "East". The Word "Falklands" seems to have been added later.

Thus immediately after his adoption of an evolutionary posture, as during his period of review and recollection during the final weeks of the voyage, Darwin seems to have seen a similar significance in the difference between the foxes of East and West Falkland as between the subtle differences between the birds of the various islets of the Galapagos archipelago. Once again Darwin's comparative approach seems to have stood him in good stead, enabling him to extract what was of importance about the similarities and differences between two environments.[12]

Animal numbers, the concept of competition and the struggle for existence

But before leaving our examination of Darwin's biological analysis of aspects of the Falkland Islands environment, there is one more set of observations that we should note, for in them are to be found the germ of one of his most important conceptual contributions on the *mechanism of evolution*. Here is a detailed description of the eggs of *Doris* (sea slug, Opisthobranchia), in the pages of the *Zoological Diary*, dated 9 March 1833:

> . . . Eggs deposited in a ribbon, this adheres by its edge to the rock in a special oval of 4 or 5 turns, is evidently formed by the turning of the animal on its centre. – & the distance of axis is the length from generative aperture to centre of revolution in the foot: Eggs in diameter .003, are collected in number from 2 to 5, generally 4 in a [sic] oval transparent case or ball, length .012: These balls are arranged two deep in transverse rows in the ribbon: In a large collection, the ribbon must be 20 inches long, in breadth it is .5 of inch; from counting how many balls in a tenth of inch & how many rows in same length, at the smallest computation there could not have been less than the enormous number of six hundred thousand eggs. – This is a wonderful instance of fecundity: yet the animal is certainly not common: I only saw seven individuals.
>
> (DAR 30.2/151–152)

Darwin later used this example in a footnote in *The Voyage of*

the Beagle. Although no evolutionary significance was attached to the note at the time, it is interesting that even at this early point in his career Darwin was fascinated by the fecundity of organisms, and appreciated how important was the fact of the destruction of enormous numbers of organisms before adulthood. Twenty-six years prior to the publication of *On the Origin of Species*, the young naturalist is already but a few short steps from the notion of natural selection.

Another observation, in some respects comparable, he developed to an even lesser extent at the time. South of the main range of East Falkland he noted that the feral horses were rare or absent:

> During the whole time we only saw one troop of wild horses & this was to the North of the hills. It is [a] curious thing that these horses although very numerous always remain in the East of the island. The gauchos cannot account for it.
>
> (*Diary*, 16 March 1834)

Darwin seems to be wondering why their numbers did not increase to the extent that they colonised new areas.

One might think that this simple observation on the distribution and numbers of a feral animal was of no great consequence, but it was later combined with other material to form the basis of a quite perceptive statement about limiting factors in the growth of numbers of creatures, a concept central to the development of Darwin's evolutionary ideas.

Darwin in after years corresponded with Sulivan, who after the *Beagle* voyage, commanded HMS *Arrow* on a surveying voyage to the islands, and later still lived for a while in the Falklands, and obtained a good deal of information from him. It was partly as the result of these details (eg in a letter dated 10 May 1843)[13] that the account was expanded:

> Considering that the island does not appear to be fully stocked, and that there are no beasts of prey, I was particularly curious to know what has checked their originally rapid increase. That in a limited island some check would sooner or later supervene, is inevitable; but why has the increase in the horse been checked sooner than that of the cattle? Capt. Sulivan has taken much pains for me in this enquiry. The Gauchos employed here

attribute it chiefly to the stallions constantly roaming from place to place, and compelling the mares to accompany them, whether or not the young foals are able to follow. One Gaucho told Capt. Sulivan that he had watched a stallion for a whole hour, violently kicking and biting a mare till he forced her to leave her foal to its fate. Capt. Sulivan can so far corroborate this curious account, that he has several times found foals dead, whereas he has never found a dead calf. Moreover, the dead bodies of full-grown horses are more frequently found, as if more subject to disease or accidents, than those of cattle. From the softness of the ground their hoofs often grow irregularly to a great length, and this causes lameness.

(*Voyage*)

Darwin also noted that there seemed to be analogous factors preventing the increase in numbers and natural spread of of the rabbits on the Falkland Islands:

The Gauchos (who as I have more than once remarked are excellent observers) maintain . . . the rabbits of their own accord do not spread to different parts of the Is^{d}. . . . Rabbits of no kind are found in the small outlying Is^{d}. & in the central part of the great Is^{d}. I saw none south of the main range, because, as the Gauchos said, they had not been taken there.

(DAR 29.1/15)

Similar material is incorporated in the first draft of *On the Origin of Species*, the "Big Species Book" as Darwin called it, only published a century after his death as *Charles Darwin's Natural Selection*. In typical Darwin fashion, his own observations from his sojourn in the Islands are combined with material from Sulivan's letters in working out his ideas on the "struggle for existence":

. . . in the Falkland Islands, there are no droughts, or injurious flies, or ticks or [blood-sucking] bats, & the cattle are magnificent animals & have multiplied greatly; but, as I am informed by Capt. Sulivan, who has kept cattle in these islands, every few years a hard winter like the 1849 destroys numbers, & even those that survive in the following spring are so much weakened that many die of diseases & get lost in the bogs. – The Horses there do not suffer so much from the snow, as their

instinct teaches them to scrape the ground with their hoofs; but oddly enough they have multiplied far less than the cattle & here were left to the eastern end; though the western is the more fertile: the Gauchos can account for this only from the stallions constantly roaming from place to place & compelling by kicks & bites the mares to desert their young: Capt. Sulivan can so far corroborate this statement that he has several times found young foals dead, whereas he has never found a dead calf. Horses here deteriorate in size, & they are apt to grow lame from the boggy soil, so climate here, no doubt, aids in checking their increase but the fact of their not spreading seems to show that the check falls chiefly on the young. I may add that Rabbits, though very numerous in parts of the Falklands likewise have not spread: what is the check here, I have no idea. . .
(*Natural Selection*, Chapter V entitled "The struggle for existence as bearing on natural selection", pages 19–20; completed March 1857)

Whatever the true explanation of the strange behaviour of the horses described here, the passages above show Darwin combining his own observations with those of others to generate a quite interesting analysis of the processes of competition between individuals, and the effects of this on populations. As always we also see Darwin's comparative approach: the competitive processes in populations of feral horses are compared with those of wild cattle, and, in less detail, with rabbits. The extracts are also typical of the way in which an idea or casual observation of little evolutionary significance was, developed and combined with other material to yield statements of much greater import. Time and again observations from the Falklands visits were later re-worked, or were in some other way linked to Darwin's later work.

But it was not only the facts that some check appeared to act on the numbers on the introduced Falklands animals, and that competition existed. From quite an early time Darwin was able to see that the "struggle for existence" might have important effects on the population as a whole, and the Falklands provided examples. Richard Grove pointed out in 1985, that on the back cover of his copy of Fremont's *Report of the Exploring Expedition to the Rocky Mountains* Darwin wrote:

It might well happen, as in horse of Falkland that the old

animals might live at ease and not be driven out to search new countries, open to them (as is evidently the case of the buffalo) and the pressures chiefly falling on the young – this is important, to observe that no selection could aid horse in Falkland, or horse in Paraguay, except strength of constitution or breeding at diff. times of year; but that cd. be effected only if a little earlier or later was not favourable.

This was apparently written in 1845 (ie after Darwin had firmly but secretly adopted the evolutionary outlook that he set out in some detail in the *Essay of 1844*); Darwin is considering differences in the responses of immature and adult individuals to selection pressure, the notion of the expansion of range, variations of individuals in their "constitution" and the possible advantages imparted by early breeding. Traces of the same ideas appear in chapter II (Volume 1) of *The Variation of Animals and Plants under Domestication*: first published in 1868:

> . . . in the Falkland Islands, the offspring of the horses imported in 1764 have already deteriorated in size and strength that they are unfitted for catching wild cattle with a lasso; so that fresh horses have to be brought from La Plata at great expense.[14]

> [A]boriginally the horses must have inhabited countries annually covered with snow, for he long retains the instinct of scraping it away to get at the herbage beneath. The wild tarpans of the East have this instinct; and so it is, as I am informed by Admiral Sulivan, with the horses recently and formerly introduced from La Plata, some of which have run wild; this latter is remarkable, as the progenitors of these horses could not have followed this instinct during many generations in La Plata. On the other hand, the wild cattle of the Falklands never scrape away the snow, and perish when the ground is long covered.

Note how the description of the snow-clearing instinct in Falklands horses is re-used. As was shown earlier in this chapter, Darwin was, from his time on the *Beagle* interested in animals' instinctive behaviour.

Many of the same ideas – the comparison with the Pampas, the concept of reversion to an earlier type, the notion of one "race" or "sub-breed" of an animal being derived from another, and the idea of that change in form was imposed by the environment – all

appear in a passage chapter VII of *The Descent of Man*:

> We know also, that the horses taken to the Falkland Islands have during successive generations become smaller and weaker, whilst those which have run wild on the Pampas have acquired larger and coarser heads; and such change are manifestly due, not to any one pair, but to all the individuals having been subjected to the same conditions, aided, perhaps by the principle of reversion.

Darwin's observations on the animals in the Falkland Islands, wild, and feral, supplemented by facts he gleaned from correspondence with his old shipmate Sulivan appear again and again throughout Darwin's writings. Skilfully recombined in different ways the materials are utilised to bring out the varied but related themes of competition, "the struggle for existence", checks to population growth and to expansion of range, evolutionary change over time, reversion to earlier type, instinctive behaviour and its persistence for many generations.

Jackass or Magellanic penguin (*Spheniscus magellanicus*).

Chapter 6

The Falkland Islands and the geographical distributions of plants and animals: correspondence in the 1840s

Darwin's suspicions that an appreciable level of endemism existed in the Falkland Islands must have been strengthened after his return to England, when he was able to discuss his specimens with specialists in particular groups. At least one freshwater fish *Aplochiton zebra* appeared to be new, never found anywhere else. After working with Waterhouse, Darwin wrote of the Falklands fox: "I entertain . . . no doubt that the *Canis antarcticus* is peculiar to the archipelago". The linking of endemism to insularity was to prove of great importance in the development of ideas on evolution.

But the biological links between the Falklands and other southern hemisphere land masses also fascinated Darwin for a long period. For many years he carried on a correspondence with J D Hooker, perhaps his closest co-worker and confidant on all manner of biological topics, but particularly on the subject of the geographical distributions of plants. We may note in passing that Hooker was also a botanist who had visited the Falklands, Tasmania and New Zealand. The degree to which the flora of the Falkland Islands was distinctive, and the extent to which it resembled those of mainland South America, Tierra del Fuego, Tasmania, Australia, New Zealand and other peri-antarctic islands was returned to again and again in their correspondence. A few examples:

> The Falkland Isd. flora seems to combine the Patagonian with the Fuegian. I think of including it with the latter.
> (J D Hooker to Charles Darwin, 28 November 1843, DAR 100)

> The Botany of Patagonia is entirely cut off as you have remarked from that of Fuegia & the Chilean coast, is so much so that I have thought of considering its Flora separately & not connecting it with that of the latter country, further than is

unavoidable from having a few plants in the Falkland Islds.
(J D Hooker to Charles Darwin, 29 January 1844, DAR 100)

Related topics seem to have been discussed when Darwin and Hooker met on 7 and 8 December 1844 at Down. In a set of notes on their discussions made by Darwin on 8 December (DAR 100/35–37), it is clear that as well as noting similarities between the Falklands, the mainland of South America and other southern lands, other southern hemisphere resemblances were mentioned. These included those between Australia and the Cape of Good Hope; Tasmania and New Zealand; Kerguelen and New Zealand, and so on. One note reads: "The further south gone, on the islands S of New Zealand, the more American Flora becomes". Another suggests that they may have discussed the possibility of dispersal of plants by icebergs (there are several other hints in Darwin's notes and letters that he thought that icebergs might be significant mechanisms for dispersal). The colloquy continued, for a letter from Darwin to Hooker on 16 April 1845 (DAR 114.1/31) continues the discussion on icebergs, and botanical similarities amongst the southern continents and islands; it also contains an oblique reference to the Falklands, mentioning d'Urville's description of the flora of the isles, comparing many of the species with those of Europe.

The occasion of these frantic exchanges was the preparation of Hooker's *Flora Antarctica* and *Flora of New Zealand* (1844–7 and 1853–5 respectively). Although there was a fair amount of agreement between the two friends, there were differences of emphasis. Hooker was convinced that the

> plants of the Southern Ocean . . . [were] the remains of a flora that once spread over a larger and more continuous tract of land than now exists in that ocean; and that the peculiar Antarctic genera and species may be vestiges of a flora characterised by a predominance of plants which are now scattered amongst the southern islands.
>
> (*Introduction to the Flora of New Zealand*, page xxi.)

Darwin was always more amenable to ideas of long-distance dispersal – by the sea, by birds, icebergs, the wind, humans or whatever. He saw the notion almost as an extension of his evolutionary ideas: if all organisms were descended from a few

simple forms, even the world's remotest islets must have been colonised from the continents. Some organisms, of course, were incapable of making the journey, perhaps because of their incapability of surviving for any period in salt water, for example, earthworms (*see page* 110), or the larger terrestrial mammals – the latter being too large for dispersal by wind, or by rafting on tree-trunks.[1] Darwin carried on an extensive correspondence on these matters throughout much of his later life. Here is the reply he got from his old shipmate Sulivan to his enquiries about the possibilities of spread of plant material by sea and by birds:

Blackheath
Feby 2 [1854]

. . .

My dear Darwin The only vegetables I ever saw on the shores of the Falklands that had come from the mainland were trees of all sizes, chiefly the birch; these were so numerous on all the shores facing the SW that we regularly supplied both the Arrow & Philomel with fuel which pretty well cleared all accessible parts of the coast. Most of the trees had been lying for years, they were clear of bark and quite seasoned. Some had roots on them others broken off . . .

The snipe of the Falklands leaves in winter – but I do not recall any strange birds coming there.

The margin of the letter is scored in several places by Darwin.

Here is Darwin writing to his friend Charles Lyell. (Lyell was another of those who felt that "continental extension" was an important explanation of biological similarities between distant land masses.)

Although it may be strictly true that we seldom *meet* with wood or fruits floating in the sea, yet this cannot be at all in effect true: for on the Falklands, the Galapagos, the Radack & the Keeling Islands drift-wood & fruit & seeds are thrown up abundantly . . .

(Charles Darwin to Charles Lyell, July-August 1845)

In the cases of the Falklands, Galapagos and the Cocos (Keeling) Islands Darwin was, of course, speaking from personal experience.

In fact there was truth in the viewpoints of all members of the

trio: Hooker, Darwin, and Lyell. Geologists do now emphasise the idea of "a larger, more continuous area of land" than now exists in the southern Ocean – Gondwana. Many of the continents were more extensive at the time of the quaternary sea-level lowering (although not as extensive as some of the more extreme of the nineteenth century continental extensionists believed). And the process of colonisation of islands by life-forms now has an enormous literature.

Suffice it to say that this fruitful correspondence about southern hemisphere distributions and island biota, touching as it did, so often, on the Falklands, was a vital process in the development of Darwin's ideas about the transmutability of species. Indeed there is a brief mention of the Falklands in one of the chapters on geographical distributions in *On the Origin of Species*:

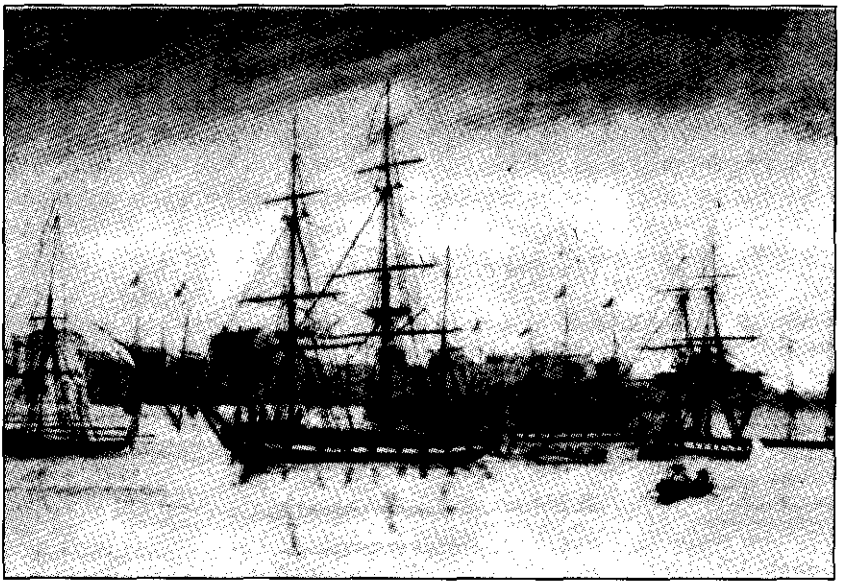
> With respect to the absence of whole orders on oceanic islands, Bory St Vincent long ago remarked that Batrachians (frogs, toads, newts) have never been found on any of the great islands with which the great oceans are studded. . . . and I have found this strictly true. . . . [A]s these animals and their spawn are known to be immediately killed by sea-water, on my view we can see that there would be great difficulty in their transportal across the sea to any oceanic island. But why, on the theory of creation, they should not have been created there, it would have been very difficult to explain.
>
> Mammals offer another and similar case. I have carefully searched the oldest voyages, but have not found a single instance, free from doubt, of a terrestrial mammal (excluding domesticated mammals kept by the natives) inhabiting an island above 300 miles from a continent; and many islands situated at a much less distance are equally barren. The Falkland Islands, which are inhabited by a wolf-like fox, come nearest to an exception; but this group cannot be considered as oceanic, as it lies on a bank connected with the mainland; moreover icebergs formerly brought boulders to its western shores, and they may formerly have transported foxes, as so frequently now happens in arctic regions. Yet it cannot be said that small islands will not support small mammals, for they occur in many parts of the world on very small islands, if close to a continent; and hardly any island can be named on which our smaller quadrupeds have

not been naturalised and greatly multiplied.

(Chapter XII, Geographical distribution – continued)

The latest thinking on the Falklands fox seems to be that it was originally semi-domesticated taken over in the canoes or other craft of Patagonian Indians, rather than on ice-flows,[2] and some scientists geologically connect the Falklands mass with the southern Africa portion of Gondwana rather than South America, asserting that it "drifted" to its present position. But these are matters of detail.[3] The essential point remains valid; wild terrestrial mammals, amphibians, reptiles, and other organisms are largely absent from the Falklands, as from other remote islands, except where they seem to have been brought by humans or other clearly comprehensible agency.

Much less is made in *On the Origin of Species* of the Falklands than of the Galapagos, New Zealand, Australia or some of the other islands that Darwin visited on the voyage of HMS *Beagle*. But discussions amongst the trio of Darwin, Hooker and Lyell in the 1840s concerning their biota were of great importance in the preparations for the writing of Darwin's best-known work.



H.M.S. BEAGLE.

'National Maritime Museum'

Charles Darwin: Naturalist

Chapter 7

The long-term significance of Darwin's visits

The scientific significance of the Falkland visits

Darwin was NOT an evolutionist by the time he visited the Falklands, and it would be quite unreasonable to suggest that his experiences in the Falkland archipelago, much of which he described as drab and monotonous, were fundamental in the development of his ideas. And yet, and yet . . . The Falklands provided the first island environment of real consequence that Darwin was able to investigate in any detail. Here we can see his methods of working – collecting, observing, note-taking, comparing, revising – being well developed. He admitted in his letters to his sisters and to Henslow that his techniques were improving as the result of experience. A careful scrutiny of writings from the two Falklands interludes reveals traces of many ideas that were to prove important later. Some of these include: an interest in animal behaviour, an appreciation of instinct, an ecological understanding, a comprehension that there were links between humans and nature, long distance dispersal, the individuality of island biota, the enormous fecundity of some organisms and the destruction that results from this, the notion that there may be checks in the expansion of a population, a realisation that the world around had undergone changes, and the importance of fluctuations in sea level. We may perhaps be permitted to say that the Falklands at least formed an important testing-ground for ideas and techniques applied with more immediate moment later. In Darwin's writings from the Falklands period we can see the "unfinished naturalist" developing his comparative approach, and the integrative powers that were to prove so useful and important.

The Falklands were also an environment from which substantial amounts of data were accumulated for later use: as with some of the material that he brought home from the Galapagos, the significance of some of his specimens only emerged fully when he was able to discuss them in London and Cambridge with the leading

scientists of the day. Thus it was only when his fossils had been carefully examined by Morris and Sharpe that they provided a measure of support for his view that fossils from different areas of the globe differed as did modern creatures. And it was only when the skins of the Falklands foxes from East and West Falkland had been considered in the light of discussions with Hooker and Gould that their significance began to emerge (*see page* 114). It was also partly Darwin's interest in "all relating to the Falklands",[1] and his collection of plants from the archipelago, that fuelled his interesting correspondence with Hooker about southern hemisphere plant distributions.

Darwin's predictions concerning the human occupance of the Falklands

As regards the human settlement of the Falklands, Darwin was extremely far-seeing, although his views may have been partly based on discussions he had with Captain FitzRoy and the other officers aboard the *Beagle*. A couple of passages in letters to Caroline and Catherine are of interest:

> These islands . . . from their local situation will be of great importance to shipping; from this Cause the Captain intends making an accurate survey.
> (Charles Darwin to Caroline Darwin, 30 March 1833; DAR 223)

> This island must some day become a very important halting place in the most turbulent sea in the world. – it is midway between Australia & South Sea to England. Between Chili Peru &c & the R. Plata & R. de Janeiro. There are fine harbors, plenty of fresh water & good beef . . .
> (Charles Darwin to Catherine Darwin, 6 April 1834, DAR 223)

With the booming goldfields of Australia and western North America in the later years of the nineteenth century, Darwin's prognosis proved entirely accurate. The litter of wrecks that sprinkles the coasts of the Falklands today, many of them Cape Horners from this period, shows that FitzRoy's insistence on accurate hydrographic survey was not misplaced.

On trivial details too, Darwin was sometimes remarkably prescient. In his discussion of the horses of the islands he foresaw:

> At some future period the southern hemisphere will probably have its breed of Falkland ponies, as the northern has its Shetland breed.

For many years in the nineteenth and early twentieth century horses remained the principal mode of land transport, and even today have not been entirely displaced by the Land Rover. In 1891 300 horses were gathered at a sports meeting at Darwin.[2] Falklands horses hardly constitute a distinctive breed in the same sense as the Shetland pony, but horses from the islands are highly esteemed (see Fig 7.1).

Two further points may be made.

First, Darwin appreciated that after some 70 years of intermittent human occupance, substantial changes had already been wrought in the environment. Cattle, horses and rabbits had already been introduced, and some native species were already coming under pressure. Of the warrah, the Falkland fox, Darwin wrote:

> The number of these animals during the last fifty years must have been greatly reduced; already they are entirely banished from that half of East Falkland which lies East of the head of Salvador Bay and Berkeley Sound; and it cannot, I think be doubted, that as these islands are now becoming colonized, before the paper is decayed on which this animal has been figured, it will be ranked among those species which have perished from the face of the earth.
> (*Zoology of the Voyage of the Beagle*, vol. II, page 10, based on notes in *Zoological Diary* See Figure 5.2)

How right he was. The Falklands fox was extremely tame: Darwin noted that they were easily killed by a gaucho holding a piece of meat in one hand, and a knife in the other. The grass was also sometimes set on fire "so that the country was in a blaze as far as the eye could reach, for several days, and we could see them running to seek other quarters." The result of this persecution was that the species was exterminated. The last was killed by settlers at Shallow Bay, West Falkland in 1876[3], well within Darwin's lifetime.

Second, it is particularly ironic that friction over the Falklands

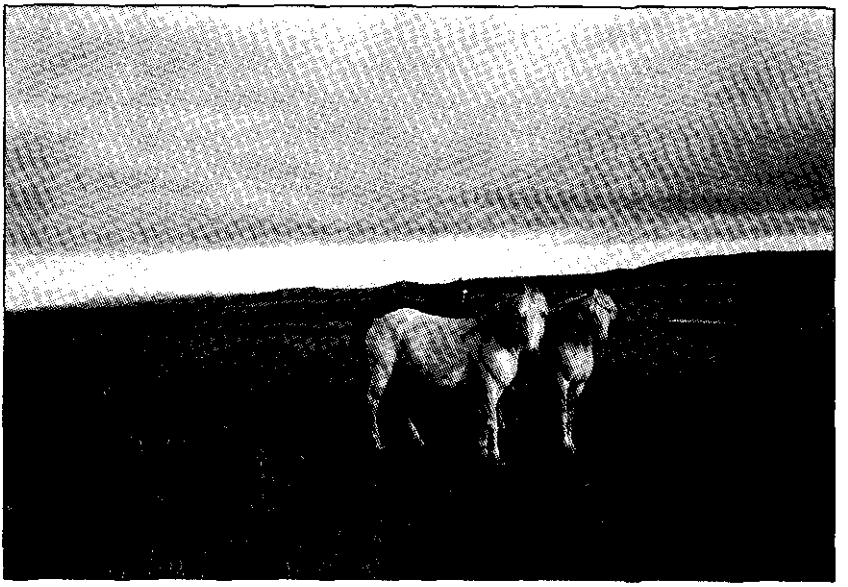


Figure 7.1. "At some future period the southern hemisphere will probably have its breed of Falkland ponies." Photograph: Patrick Armstrong

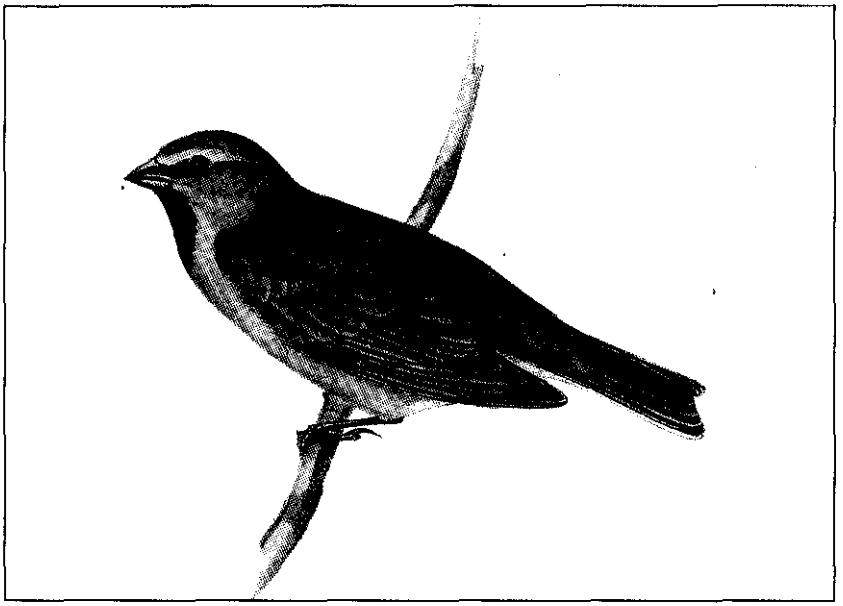
between Britain and Buenos Aires should persist over the entire period between Darwin's visit and the present. On 30 March 1833, Charles wrote to his sister Caroline:

> We arrived here in the Falkland Islands in the beginning of this month . . . We found to our great surprise the English flag hoisted. – I suppose the occupation of this place, has only just been noticed in the English papers; but we hear all the southern part of America is in ferment about [it]. By the awful language of Buenos Ayres one would suppose this great republic meant to declare War against England!
> (Charles Darwin to Caroline Darwin, 30 March 1833; DAR 223)

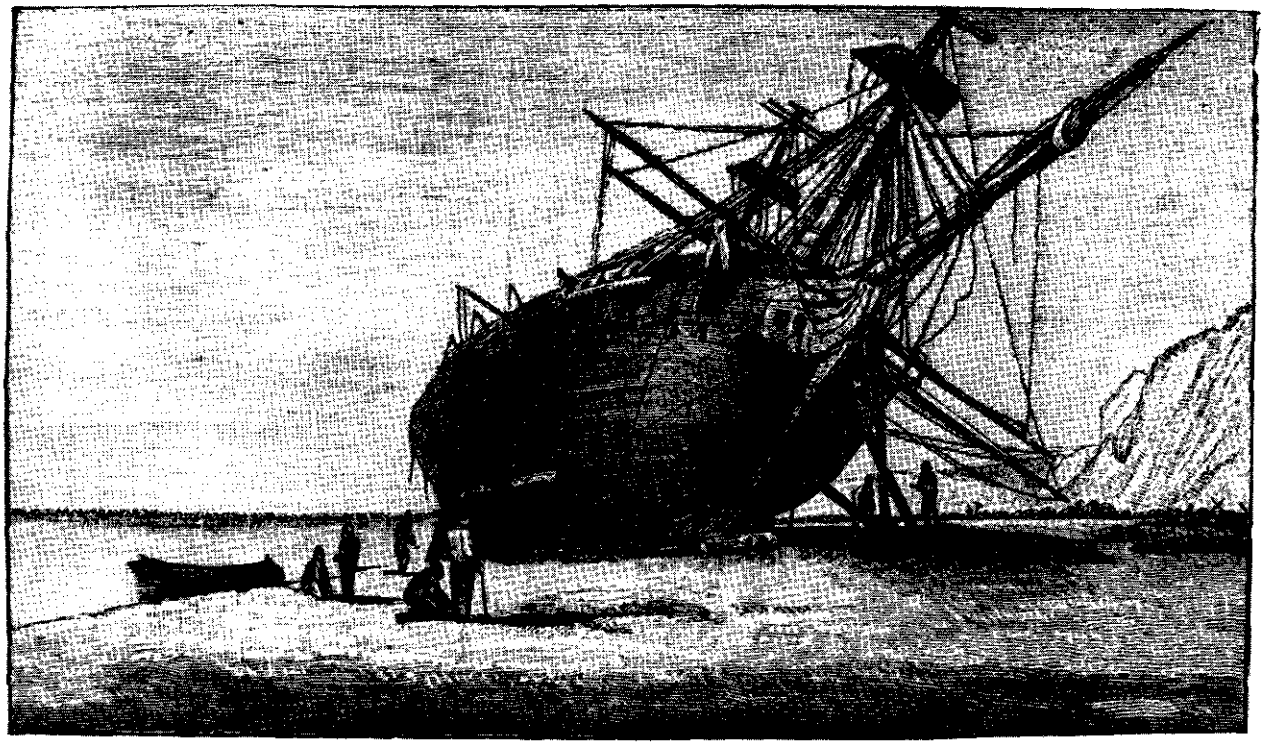
Exactly 149 years later, almost to the day, Britain and the "great republic" of Argentina were at war over the Falklands, or at least in a state of armed conflict. The modern visitor to East Falkland, landing at Mount Pleasant Airport, seeing the substantial British Army and RAF presence, is immediately aware that the Falkland Islands remain, as Darwin perceptively put it, "a bone of contention between Nations".

Darwin in later life, was the epitome of the "gentle scientist". While he did not particularly like the Falkland Islands – he thought the landscape was bleak, the weather appaling,[4] and the place had for him recollections of thuggery, hideous scheming, murder and shipwreck. Nevertheless he appreciated the islands scientific importance, and the appeal of many of the curious animals and plants found there. The loss of human life in the 1982 conflict he would have regretted; the continued extinction of species would have upset him.

It is probably naïve to hope, as have some that the islands could be declared "International scientific territory".[5] But it is perhaps open to us to hope that the political future of the archipelago will be settled by something short of war, and, to use another of Darwin's phrases, that "this centre of creation" will achieve a measure of international recognition as a set of scientific sites of exceptional importance, and the conservation and management that the greatest of all naturalists would have wanted for them.



"Chlorospiza? xanthogramma." – (Modern name *Melanodero xanthogramma*, or yellow-bridled finch). "This species is common at the Falkland Islands", wrote Darwin but it now appears to be extinct, perhaps due to habitat changes through overgrazing.



The *Beagle* ashore on the South American Coast.

Notes

Introduction

1 R Grove, 1985, Charles Darwin and the Falkland Islands, *Polar Record*, 22 (139), 413–420.

2 F J Sulloway, 1982, Darwin's conversion: the *Beagle* voyage and its aftermath, *Journal of the History of Biology*, 15 (3), 325–396.

——, 1983, Further remarks on Darwin's spelling habits and the dating of *Beagle* voyage manuscripts, *Journal of the History of Biology*, 16 (3), 361–390.

——, 1984, Darwin and the Galapagos, Biological *Journal of the Linnean Society of London*, 21, 29–59.

Chapter 1

1 Microfilms of the "little note-books" were used for this study, although the original leather-covered books were inspected at Down House.

2 Benjamin Bynoe (1804–1865), initially assistant surgeon, held the post of *acting* surgeon on the *Beagle* from April 1832 onwards; he seems to have been very competent and letters from Captain FitzRoy to the Admiralty urged that he be promoted to full surgeon's rank. He attended Darwin when he was ill in South America. Nominally Bynoe also had duties as Naturalist (Darwin always being a supernumerary); his "Remarks upon the Falkland Islands" (soil, crops, plants, animals etc), prepared for the original edition of the *Sailing Directions* of FitzRoy and Sulivan (manuscript held by Ministry of Defence, Taunton) are detailed and accurate. See also chapter 5, note 11.

3 I J Strange, 1987, *The Falkland Islands and their natural history*, David and Charles, Newton Abbot.

4 The *Phucocoetes latitans* specimen numbers are: BM[NH] 1917.7.14. 67 and 68.

5 The *Aplochiton zebra* specimen numbers are: BM[NH] 1917.7.14. 2 and 3.

6 The code numbers of the FitzRoy specimens of *Dusicyon australis* (the warrah) are: the West Falkland skin (a female) – BM 37.3.15.48, and the East Falkland specimen (a male) BM 37.3.15.47. The former bears the label *Dusicyon antarcticus*, the latter *D. darwinii*. For accounts of the biology of the genus *Dusicyon* see: J Clutton-Brock, C

B Corbet and M Hills, 1985, *Bulletin of the British Museum (Natural History): Zoology*, 29 (3), 191–199. Also: J. Clutton-Brock, 1977, "Man-made dogs", *Science*, 197, 1340–1342, 30 September 1977.

7 For a full account of the collections of specimens made on the voyage, see D M Porter, 1985, The *Beagle* collector and his collections, in D Kohn, *Darwinian Heritage*, Princeton University Press, 973–1019. The insect collections and the notes on them are described in detail in: K G V Smith (ed) "Darwin's insects", *Bulletin of the British Museum (Natural History) (Historical Series)*, 14 (1): 1–143, 24 September 1987.

8 P H Armstrong, 1985, *Charles Darwin in Western Australia: a young scientist's perception of an environment*, University of Western Australia Press, Nedlands.

——, 1991, *Under the blue vault of heaven: Charles Darwin's sojourn in the Cocos (Keeling) Islands*, Indian Ocean Centre for Peace Studies, Nedlands.

9 See F J Sulloway, 1982 (Introduction, note 2).

10 D Lowenthal, 1961, "Geography, experience and imagination: towards a geographical epistemology", *Annals of the Association of American Geographers*, 51 (3), 241–260.

11 H Gruber and P Barrett, 1974, *Darwin on Man*, Wildwood House, London.

12 D Ospovat, 1981, *The development of Darwin's theory: natural history, natural theology, natural selection*. Cambridge University Press.

13 F J Sulloway, 1985, "Darwin's early intellectual development: an overview of the *Beagle* voyage", in D Kohn (ed), *The Darwinian Heritage*, Princeton University Press.

14 J Bowlby, 1990, *Charles Darwin: a biography*, Hutchinson, London.

15 J F W Herschel, 1830, *Preliminary Discourse on the Study of Natural Philosophy*, London: Longman, Rees, Orme, Brown & Green. Darwin's edition was rebound as part of "The Cabinet Cyclopaedia", 1831. The quotation is from Part II, chapter VI, page 167.

16 M Springler (English Department, University of Western Australia), personal communication.

17 Darwin wrote an autobiography as a private family record in the last five years of his life. It was only in published in 1958, nearly eighty years after his death, edited by his grand-daughter Nora Barlow, as *The Autobiography of Charles Darwin 1809–1882*, Collins, London.

18 The Reverend Professor John Stevens Henslow (1796–1861). At the time that Darwin knew him at Cambridge he was Professor of Botany,

and curate of St Mary the Less. He was an enthusiastic teacher, and lifelong friend of Darwin. Several notes written by Darwin testify to the fact that Henslow carefully instructed him in the collection, labelling and preservation of specimens.

19 See K G V Smith, 1987, note 7, above.

20 Syms Covington (1816?–1861). initially "fiddler and boy to poop cabin", he became Darwin's servant on the *Beagle* in 1833, and was maintained by him as a servant, secretary and assistant for the remainder of the voyage, and on his return to England. Covington emigrated to New South Wales in 1839.

21 K G V Smith, 1987, page 79; see note 7 above. See also G R Waterhouse, 1843, "Descriptions of the Coleopterous insects brought from the Falkland Islands by Charles Darwin, Esq.". *Annals and Magazine of Natural History*, (1) 11, 281–283.

22 The Reverend Professor Adam Sedgwick (1785–1875). He was Fellow of Trinity College and Woodwardian Professor of Geology in the University of Cambridge (1818–1873); he was an authority on the rocks of the Lower Palaeozoic.

Chapter 2

1 See chapter 1, note 2.

2 The French nobleman Antoine Louis de Bourgainville, with Dom A J Pernety (sometimes spelled "Pernetty") as priest, naturalist and recorder, established the first settlement at Port Louis (named after the French King) in Berkeley Sound in February 1764. A square fort, with turf walls was constructed; its remains still exist, partly covered by a scrub of gorse, diddle dee and Christmas bush. Later a well-built, stone barracks was constructed; this also remains, and indeed is lived in by the manager of the Port Louis farm, and his family. See page 18.

3 For more detailed accounts of the lithology and palaeontology of these rocks see, for example:
E T Newton, 1906, "Notes on fossils from the Falkland Islands brought home by the Scottish National Antarctic Expedition in 1904", *Proceedings of the Royal Physical Society of Edinburgh*, 16 (6), 248–257.
M Greenway, 1972, "The Geology of the Falkland Islands", *British Antarctic Survey Scientific Reports*, No. 72.

Chapter 3

1 Accounts of the incident differ. An apparently authoritative recon-

struction appears in: R S Boumphrey, 1961, The murders at Port Louis, 1833, in B J Benedikt (ed) *Studia Centenalia in Honorem Memoriae, Benedikt S Thorarinsson*, 1861–1961, 115–133, Isafoldarprentstmidja, Reykjavik.

2 Syms Covington's diary account of the incident, which cannot be regarded as entirely reliable, reads:

> Berkeley Sound, Port Louis. On our arrival here, which was the second time, we found Presbyn the Governor had been shot with 3 others by the Gauchos & others. It was said he was very tyranical to the whole of people in general. Two of the murderers were secured by H M S Challenger a short time before our arrival, & 2 by our own ship, which were sent to England [to *del*]. A New Governor was left by the Challenger, with marines for his guard (A Leiutenant [sic] of the Navy).
>
> (Mitchell Library ML MSS 2009/108: 649)

Covington presumably heard Brisbane's name pronounced, but did not see it written!

3 Brisbane is now buried in the small graveyard, surrounded by a low turf wall, above the Watering Place, Port Louis. His grave bears a tombstone with the following inscription:

> In Memory of Mr Matthew Brisbane who was barbarously murdered on the 26th, August 1833
> His Remains were removed to this Spot by the crews of H. B. M. Ships "Erebus" and "Terror" on the 25th of August, 1842
> This Tombstone was renewed by Governor Sir James O'Grady, K.C.M.G, in 1933. See page 60.

The original wooden headboard, which has a similar inscription (apart from the last sentence) is in the Falkland Islands Museum in Stanley. It also bears the words: "In command of the Beaufoy Cutter he was the zealous and able companion of Capn James Bedell [sic], during his Enterprising Voyages to beyond the 74th degree of South Latitude in February 1823". See also page 95.

4 Covington's description reads as follows:

> One of the Challenger boats capsized here. A Leiutenant [sic] & 1 or 2 others were drowned. Some of the clothes of the former were picked up on the beach by our people, & a knife.

5 FitzRoy's Narrative records:

> I must not omit the 'tea-plant', made from which I have drunk many cups of good tea, and the settlers use it frequently. It has a peculiar effect on some people, which of no consequence and soon goes off. This little plant grows like a heath in many parts of the Falklands as well as in Tierra del Fuego, and has long been used by the sealers.

At my own table I have seen it drank by the officers without their detecting the difference: yet the only tea I used at other times was the best that could be obtained in Rio de Janeiro.

The modern scientific name for the Falklands tea plant or teaberry is *Myrteola nummularia*.

6 Fachine, *Chiliotrichum diffusum*, is another possibility.

7 The name, *Adventure* was chosen as it was the name of the sister-ship of the *Beagle* on the first voyage to South America, under Captain King. (See also page 32.)

Captain FitzRoy hoped, indeed virtually assumed, that their Lordships of the Admiralty would reimburse him for this, despite the fact that the purchase of the vessel was completely unauthorised. They did not, although there was a protracted correspondence. FitzRoy maintained that the reason was political; that the government was in hands of the Whigs whereas FitzRoy's family had always been Tory. The matter was a source of aggravation for the rest of his days.

8 Fossil forms: *A monograph of the fossil Lepadidæ, or pedunculated cirripedes of Great Britain . . . A monograph of the fossil Balanidæ and Verrucidae of Great Britain*, Palæontographical Society, London, 1851–1858.

Living forms: *A monograph of the sub-class Cirripedia . . . The Lepadidæ; or pedunculated cirripedes . . . The Balanidae (or sessile cirripedes), the Verrucidae*, Ray Society, London, 1852–1854.

Chapter 4

1 See: J R F Joyce, 1950, "Stone runs of the Falkland islands", *Geological Magazine*, 87 (2), 105–115. This author accepts that solifluction may be a partial explanation, but that the nature of the relationships amongst the lithology of the "upper series" quartzites, the distribution of fold systems and topography also involved: "Stone runs are . . . largely an accident of past climate and the structure and lithology. . . " These views are criticised by Mary Greenway (Chapter 2, note 3). She argues that they were set down before the wide distribution of stone runs in West Falkland was appreciated: that island having a quite different tectonic structure.

2 See pages 90-97 on the sources and nature of Darwin's "catastrophist" views.

3 An up-to-date treatment of the topic is given in: C M Clapperton and D E Roberts, 1986, "Quaternary sea level changes in the Falkland Islands", in J Rabassa (ed), *Quaternary of South America and Antarctic Peninsula*, 4, 99–117.

4 R J Aidie and M E Greenway, 1972 *Geological Map of the Falkland Islands (East Sheet)*, Directorate of Overseas Surveys, London.

5 The name "Desolation Island" was also used for both Heard Island and Kerguelen by sealers, but Brisbane never had any connection with these Indian Ocean peri-antarctic islands.

Chapter 5

1 F J Sulloway, 1985, Darwin's early intellectual development: an overview of the Beagle voyage (1831–1836), in: D Kohn (ed) *The Darwinian Heritage*, Princeton University Press, 121–154.

2 There are at least three species of kelp, each growing in different depths of water: *Macrocystis pyrifera* (giant kelp), *Durvillea antarctica* (giant tree kelp), and *Lessonia antarctica* (tree kelp).

3 See J H Winslow, 1970, *Darwin's geographical outlook: a study of the relationship between his personality, education and environmental perception*, PhD thesis, University of Cambridge.

4 See page 129, and also chapter 1, note 6. J Clutton-Brock believes that the extreme and extra-ordinary tameness of the warrah described by Darwin and other early authors such as Byron and Pernety might be explained by its ancestral form being a domestic animal from South America. She and a few other authors such as I J Strange (chapter 1, note 3) suggest that the Falklands fox or wolf was carried to the Falklands in canoes, by South American Indians.

5 Both *On the Origin of Species* (1859) and *The Descent of Man* (1871) place considerable emphasis on the subject of instinct.

6 The text of *On the Origin of Species* was in fact an "abstract" or "digest" of a much longer work, that Darwin called his "Big Species Book", written between 1856 and 1858. It was published in 1975, edited by R C Stauffer, as *Charles Darwin's Natural Selection*, Cambridge University Press.

7 The "vicariance versus dispersal" remains an important focus for discussion in biogeography. For example:
J A Taylor (ed), 1984, *Themes in Biogeography*, Croom Helm, London. Note particularly the first two chapters. P Stott, 1981, *Historical Plant Geography: an Introduction*, George Allen and Unwin, London.

8 See Introduction, note 1.

9 See Introduction, note 2.

10 See above, and note 6.

11 Benjamin Bynoe the acting surgeon seems to have been recording partly as a surgeon, and partly as a naturalist, when in his "Remarks upon

the Falkland Islands", written in March 1833, he observed:

> There is an extraordinary plant growing about the dry flats at the back of the Settlement, it forms itself into large round Mounds growing so compactly as to render it quite hard, it yields a kind of Aromatic Gum, or Resin, which the settlers call Balsam, they use it quite fresh for wounds, & it answers at least the purpose of Sticking Plaster. In summer a great quantity can be collected without injuring the plants. On warm days it oozes out spontaneously in great quantities. The whole plant, even when green is very inflammable, the Gauchos tear it asunder, set it on fire, and roast their beef before it; the same plant is to be met with abundantly in Tierra del Fuego.

Bolax gummifera still grows close to Port Louis.

12 See chapter 1, note 6.

13 Lieut B J Sulivan (later Admiral) returned to the Falklands in 1838, and with the vessels *Arrow* and *Philomel* continued surveying. Later still he farmed in the Islands. He corresponded with Darwin throughout his life, and is the source of some of the material on the Falklands in several of Darwin's publications. The 1843 letter was cut up by Darwin, and portions stored in different places, according to their content. Pieces are classified in Cambridge as DAR 46.1/70–74; 39.1/26–27 and 66–67.

The behaviour of the wild horses and cattle of the Falklands continued to fascinate. Sulivan also wrote, years after, to Darwin:

> Bournemouth
> Feb 13 [1868?]
>
> My dear Darwin,
>
> . . .
>
> As you are so interested in all relating to the Falklands, I think you may like to hear a fact about the horses if I have not told you it before.
>
> There were two wild stallions each with his small troop of mares in the hills above Port William, and it is quite certain that they never would have been near each other without fighting. The Young English Horse I took out was running under these hills with eight mares & several times these wild horses had singly tried to fight him for his mares – but he was more than a match for either of them. One day these two came in together and attacked him. Our captain saw it from the house and when he rode to the spot one horse was keeping the horse engaged while the other was driving away the mares and had got four away from the rest. We settled it by driving the whole party into our Corral for the wild one stuck to the mares.
>
> (DAR 83/188-189)

14 Darwin noted in one of his "little note books" (1.8) on 17 March 1834, while he was travelling across East Falkland with the gauchos:

Horses very expensive 100 ps each. –

Out of 29–10 arrived safe & 4 now alive . . .

Chapter 6

1 However, FitzRoy speculated in his Narrative:

> [W]hy might not foxes have . . . drifted from Eastern Tierra del Fuego direct. I have heard somewhere, though I cannot recollect the authority, that a man in North America hauled a large old tree to the bank of a river in which it was floating towards the sea, . . . when to his astonishment out of a hole in the tree jumped a fine fox.

He thought it possible that Staten Island (Isla de los Estados) might have formed a "staging post", and that icebergs might provide an alternative mechanism, commenting on the direction of ocean currents in the vicinity of the southern tip of South America.

2 See note 1, above.

3 For an early attempt to reconstruct Gondwana with the Falklands positioned off the west coast of South Africa, see R J Aidie, 1952, "The position of the Falkland Islands in a reconstruction of Gondwanaland", *Geological Magazine*, 89 (6), 401–410.

Chapter 7

1 B J Sulivan to Charles Darwin, 13 February 1868 (DAR 83/188).

2 I J Strange (1987), see chapter 1, note 3.

3 R Woods, 1988, *Guide to the birds of the Falkland Islands*, Anthony Nelson Ltd, Oswestry.

4 See page 55.

5 R Grove, 1985, see Introduction, note 1.

Note added in proof:
A recent study suggests that the fish *Aplochiton zebra* (page 3) may be found in Southern Chile and in the Falklands. R M McDowall and K Nakaga, Identity of Galaxiod fishes of the genus *Aplocihton, Jenyns,* from Southern Chile. *Japanese Journal of Ichthyology*, 34, 377–383 (1987). If correct, it would be inaccurate to describe the species as Falklands endemic.

Index

This index includes names of persons, places, ships and scientific names of organisms (genera and species only).

D

E

F

G

H

J

K

L

M

N

O

P

R

S

T

U

V

W

Index of Figures and Illustrations

Chapter 4

Chapter 5

Chapter 7