VOYAGES
OF THE
ADVENTURE
AND
BEAGLE.

VOL. III.

DARWIN.

COLBURN
LONDON

VOYAGES

OF THE

ADVENTURE AND BEAGLE.

VOLUME III.

NARRATIVE

OF THE

SURVEYING VOYAGES

OF HIS MAJESTY'S SHIPS

ADVENTURE AND BEAGLE,

BETWEEN

THE YEARS 1826 AND 1836,

DESCRIBING THEIR

EXAMINATION OF THE SOUTHERN SHORES

OF

SOUTH AMERICA,

AND

THE BEAGLE'S CIRCUMNAVIGATION OF THE GLOBE.

IN THREE VOLUMES.

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JOURNAL AND REMARKS.

1832—1836.

BY

CHARLES DARWIN, ESQ., M.A.

SEC. GEOL. SOC.

PREFACE.

I HAVE stated in the preface to the Zoology of the Voyage of the Beagle, that it was in consequence of a wish expressed by Captain FitzRoy, of having some scientific person on board, accompanied by an offer from him, of giving up part of his own accommodations, that I volunteered my services, which received, through the kindness of the hydrographer, Captain Beaufort, the sanction of the Lords of the Admiralty. As I feel that the opportunities, which I enjoyed of studying the Natural History of the different countries we visited, have been wholly due to Captain FitzRoy, I hope I may here be permitted to express my gratitude to him; and to add that, during the five years we were together, I received from him the most cordial friendship and steady assistance. Both to Captain FitzRoy and to all the Officers of the Beagle,*

* I must likewise take this opportunity of returning my sincere thanks to Mr. Bynoe, the surgeon of the Beagle, for his very kind attention to me when I was ill at Valparaiso.

I shall ever feel most thankful for the undeviating kindness with which I was treated, during our long voyage.

The present volume contains in the form of a journal, a sketch of those observations in Geology and Natural History, which I thought would possess some general interest. As it was originally intended to have preceded any more detailed account, and as its publication has been unavoidably delayed, the briefness and imperfection of several parts, I hope, will be excused. I have given a list of those errata (partly caused by my absence from town when some of the sheets were in the press) which affect the sense; and have added an Appendix, containing some additional facts (especially on the theory of the transportation of erratic blocks) which I have accidentally met with during the past year. I hope shortly to publish my geological observations; the first Part of which will be on the Volcanic Islands of the Atlantic and Pacific Oceans, and on Coral Formations; and the second Part will treat of South America. Several numbers of the Zoology of the Voyage of the Beagle, due to the disinterested zeal of several of our first naturalists, have already appeared. These works could not have been undertaken, had it not been for the liberality of the Lords Commissioners of Her Majesty's Treasury, who, through the representation of the Right Honourable the Chancellor of the Exchequer, have been pleased to grant a sum of one

thousand pounds towards defraying part of the expenses of publication. I have repeated in this volume my account of the habits of some of the birds and quadrupeds of South America, as I thought such observations might interest those readers who would not, probably, consult the larger work. But I trust that naturalists will remember, that mere sketches are here given on several subjects, which will hereafter be more fully entered on, or have already been so:—for instance, the notices of the strange fossil quadrupeds of the eastern plains of South America are exceedingly imperfect, whilst an admirable account of them by Mr. Owen now forms the first part of the Zoology of the Voyage of the Beagle.

I shall have the pleasure of acknowledging the great assistance I have received from several naturalists, in the course of this and the succeeding works; but I must be here allowed to return my most sincere thanks to the Reverend Professor Henslow, who, when I was an under-graduate at Cambridge, was one chief means of giving me a taste for Natural History, —who, during my absence, took charge of the collections I sent home, and by his correspondence directed my endeavours,—and who, since my return, has constantly rendered me every assistance which the kindest friend could offer.

C. D.

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JOURNAL

OF

CHARLES DARWIN, M.A.,

NATURALIST TO THE BEAGLE.

CHAPTER I.

Porto Praya—Ribeira Grande—Dry and clear atmosphere—Effect of lava on calcareous beach—Habits of Aplysia and Octopus—St. Paul's rock non-volcanic—Incrustations and stalactites of phosphate of lime—Insects first colonists—Fernando Noronha—Bahia—Extent of granite—Burnished rocks—Habits of Diodon—Pelagic confervæ, infusoria—Causes of discoloured sea.

ST. JAGO—CAPE DE VERD ISLANDS.

JAN. 16TH, 1832.—The neighbourhood of Porto Praya, viewed from the sea, wears a desolate aspect. The volcanic fire of past ages, and the scorching heat of a tropical sun, have in most places rendered the soil sterile and unfit for vegetation. The country rises in successive steps of table land, interspersed with some truncate conical hills, and the horizon is bounded by an irregular chain of more lofty mountains. The scene, as beheld through the hazy atmosphere of this climate, is one of great interest; if, indeed, a person, fresh from the sea, and who has just walked, for the first time, in a grove of cocoa-nut trees, can be a judge of any thing but his own happiness. The island would generally be considered as very uninteresting; but to any one accustomed only to an English landscape, the novel

prospect of an utterly sterile land possesses a grandeur which more vegetation might spoil. A single green leaf can scarcely be discovered over wide tracts of the lava plains; yet flocks of goats, together with a few cows, contrive to exist. It rains very seldom, but during a short portion of the year heavy torrents fall, and immediately afterwards a light vegetation springs out of every crevice. This soon withers; and upon such naturally-formed hay the animals live. At the present time it has not rained for an entire year. The broad, flat-bottomed, valleys, many of which serve during a few days only in the season as a water-course, are clothed with thickets of leafless bushes. Few living creatures inhabit these valleys. The commonest bird is a kingfisher (*Dacelo jagoensis*), which tamely sits on the branches of the castor-oil plant, and thence darts on the grasshoppers and lizards. It is brightly coloured, but not so beautiful as the European species: in its flight, manners, and place of habitation, which is generally in the driest valleys, there is also a wide difference.

One day, two of the officers and myself rode to Ribeira Grande, a village a few miles to the eastward of Porto Praya. Until we reached the valley of St. Martin, the country presented its usual dull brown appearance; but there, a very small rill of water produces a most refreshing margin of luxuriant vegetation. In the course of an hour we arrived at Ribeira Grande, and were surprised at the sight of a large ruined fort and cathedral. The little town, before its harbour was filled up, was the principal place in the island: it now presents a melancholy, but very picturesque appearance. Having procured a black Padre for a guide, and a Spaniard, who had served in the Peninsular war, as an interpreter, we visited a collection of buildings, of which an ancient church formed the principal part. It is here the governors and captain-generals of the islands have been buried. Some of the tombstones recorded dates of the sixteenth century.*

* The Cape de Verd Islands were discovered in 1449.

The heraldic ornaments were the only things in this retired place that reminded us of Europe. The church or chapel formed one side of a quadrangle, in the middle of which a large clump of bananas were growing. On another side was a hospital, containing about a dozen miserable-looking inmates.

We returned to the "Vênda" to eat our dinners. A considerable number of men, women, and children, all as black as jet, were collected to watch us. Our companions were extremely merry; and every thing we said or did was followed by their hearty laughter. Before leaving the town we visited the cathedral. It does not appear so rich as the smaller church, but boasts of a little organ, which sent forth most singularly inharmonious cries. We presented the black priest with a few shillings, and the Spaniard, patting him on the head, said, with much candour, he thought his colour made no great difference. We then returned, as fast as the ponies would go, to Porto Praya.

Another day we rode to the village of St. Domingo, situated near the centre of the island. On a small plain which we crossed, a few stunted acacias were growing; their tops, by the action of the steady trade-wind, were bent in a singular manner—some of them even at a right angle to the trunk. The direction of the branches was exactly N.E. by N., and S.W. by S. These natural vanes must indicate the prevailing direction of the force of the trade wind. The travelling had made so little impression on the barren soil, that we here missed our track, and took that to Fuentes. This we did not find out till we arrived there; and we were afterwards very glad of our mistake. Fuentes is a pretty village, with a small stream; and every thing appeared to prosper well, excepting, indeed, that which ought to do so most—its inhabitants. The black children, completely naked, and looking very wretched, were carrying bundles of firewood half as big as their own bodies.

Near Fuentes we saw a large flock of guinea-fowl—probably fifty or sixty in number. They were extremely wary,

and could not be approached. They avoided us, like partridges on a rainy day in September, running with their heads cocked up; and if pursued, they readily took to the wing.

The scenery of St. Domingo possesses a beauty totally unexpected, from the prevalent gloomy character of the rest of the island. The village is situated at the bottom of a valley, bounded by lofty and jagged walls of stratified lava. The black rocks afford a most striking contrast with the bright green vegetation, which follows the banks of a little stream of clear water. It happened to be a grand feast-day, and the village was full of people. On our return we overtook a party of about twenty young black girls, dressed in most excellent taste; their black skins and snow-white linen being set off by their coloured turbans and large shawls. As soon as we approached near, they suddenly all turned round, and covering the path with their shawls, sung with great energy a wild song, beating time with their hands upon their legs. We threw them some vintéms, which were received with screams of laughter, and we left them redoubling the noise of their song.

It has already been remarked, that the atmosphere is generally very hazy; this appears chiefly due to an impalpable dust, which is constantly falling, even on vessels far out at sea. The dust is of a brown colour, and under the blowpipe easily fuses into a black enamel. It is produced, as I believe, from the wear and tear of volcanic rocks, and must come from the coast of Africa. One morning the view was singularly clear; the distant mountains being projected with the sharpest outline, on a heavy bank of dark blue clouds. Judging from the appearance, and from similar cases in England, I supposed that the air was saturated with moisture. The fact, however, turned out quite the contrary. The hygrometer gave a difference of 29.6 degrees, between the temperature of the air, and the point at which dew was precipitated. This difference was nearly double that which I had observed on the previous mornings.

This unusual degree of atmospheric dryness was accompanied by continual flashes of lightning. Is it not an uncommon case, thus to find a remarkable degree of aerial transparency with such a state of weather?

The geology of this island is the most interesting part of its natural history. On entering the harbour, a perfectly horizontal white band, in the face of the sea cliff, may be seen running for some miles along the coast, and at the height of about forty-five feet above the water. Upon examination, this white stratum is found to consist of calcareous matter, with numerous shells embedded, such as now exist on the neighbouring coast. It rests on ancient volcanic rocks, and has been covered by a stream of basalt, which must have entered the sea, when the white shelly bed was lying at the bottom. It is interesting to trace the changes, produced by the heat of the overlying lava, on the friable mass. For a thickness of several inches it is converted, in some parts, into a firm stone, as hard as the best freestone; and the earthy matter, originally mingled with the calcareous, has been separated into little spots, thus leaving the limestone white and pure. In other parts a highly crystalline marble has been formed, and so perfect are the crystals of carbonate of lime, that they can easily be measured by the reflecting goniometer. The change is even more extraordinary, where the lime has been caught up by the scoriaceous fragments of the lower surface of the stream; for it is there converted into groups of beautifully radiated fibres resembling arragonite. The beds of lava rise in successive gently-sloping plains, towards the interior, whence the deluges of melted stone originally proceeded. Within historical times, no signs of volcanic activity have, I believe, been manifested in any part of St. Jago. This state of quiescence is, probably, owing to the neighbouring island of Fogo being frequently in eruption. Even the form of a crater can but rarely be discovered on the summits of any of the red cindery hills; yet the more recent streams can be distinguished on the coast, forming a line of cliffs of less height, but stretching out in advance of those belonging to an older

series: the height of the cliff thus affording a rude measure of the age.

During our stay, I observed the habits of some marine animals. A large Aplysia is very common. This sea-slug is about five inches long; and is of a dirty yellowish colour, veined with purple. At the anterior extremity, it has two pair of feelers; the upper ones of which resemble in shape the ears of a quadruped. On each side of the lower surface, or foot, there is a broad membrane, which appears sometimes to act as a ventilator, in causing a current of water to flow over the dorsal branchiæ. It feeds on delicate sea-weeds, which grow among the stones in muddy and shallow water; and I found in its stomach several small pebbles, as in the gizzards of birds. This slug, when disturbed, emits a very fine purplish-red fluid, which stains the water for the space of a foot around. Besides this means of defence, an acrid secretion, which is spread over its body, causes a sharp, stinging sensation, similar to that produced by the Physalia, or Portuguese man-of-war.

I was much interested, on several occasions, by watching the habits of an Octopus or cuttle-fish. Although common in the pools of water left by the retiring tide, these animals were not easily caught. By means of their long arms and suckers, they could drag their bodies into very narrow crevices; and when thus fixed, it required great force to remove them. At other times they darted tail first, with the rapidity of an arrow, from one side of the pool to the other, at the same instant discolouring the water with a dark chestnut-brown ink. These animals also escape detection by a very extraordinary, chameleon-like, power of changing their colour. They appear to vary the tints, according to the nature of the ground over which they pass: when in deep water, their general shade was brownish purple, but when placed on the land, or in shallow water, this dark tint changed into one of a yellowish green. The colour, examined more carefully, was a French gray, with numerous minute spots of bright yellow: the former of these varied in intensity; the latter

entirely disappeared and appeared again by turns. These changes were effected in such a manner, that clouds, varying in tint between a hyacinth red and a chestnut brown,* were continually passing over the body. Any part being subjected to a slight shock of galvanism, became almost black: a similar effect, but in a less degree, was produced by scratching the skin with a needle. These clouds, or blushes, as they may be called, when examined under a glass, are described as being produced by the alternate expansions and contractions of minute vesicles, containing variously-coloured fluids.†

This cuttle-fish displayed its chameleon-like power both during the act of swimming and whilst remaining stationary at the bottom. I was much amused by the various arts to escape detection used by one individual, which seemed fully aware that I was watching it. Remaining for a time motionless, it would then stealthily advance an inch or two, like a cat after a mouse; sometimes changing its colour: it thus proceeded, till having gained a deeper part, it darted away, leaving a dusky train of ink to hide the hole into which it had crawled.

While looking for marine animals, with my head about two feet above the rocky shore, I was more than once saluted by a jet of water, accompanied by a slight grating noise. At first I did not know what it was, but afterwards I found out that it was the cuttle-fish, which, though concealed in a hole, thus often led me to its discovery. That it possesses the power of ejecting water there is no doubt, and it appeared to me certain that it could, moreover, take good aim by directing the tube or siphon on the under side of its body. From the difficulty which these animals have in carrying their heads, they cannot crawl with ease when placed on the ground. I observed that one which I kept in the cabin was slightly phosphorescent in the dark.

St. Paul's Rocks.—In crossing the Atlantic we hove to,

* So named according to Pat. Symes's nomenclature.

† See Encyclo. of Anat. and Physiol., article *Cephalopoda*.

during the morning of February 16th, close to the island of St. Paul. This cluster of rocks is situated in 0° 58′ north latitude, and 29° 15′ west longitude. It is 540 miles distant from the coast of America, and 350 from the island of Fernando Noronha. The highest point is only fifty feet above the level of the sea, and the entire circumference is under three-quarters of a mile. This small point rises abruptly out of the depths of the ocean. Its mineralogical constitution is not simple; in some parts, the rock is of a cherty, in others, of a felspathic nature; and in the latter case it contains thin veins of serpentine, mingled with calcareous matter.

The circumstance of these rocks not being of volcanic origin is of interest, because, with very few exceptions, the islands situated in the midst of the great oceans are thus constituted. As the highest pinnacles of the great mountain ranges probably once existed as islands distant from any continent, we are led to expect that they would frequently consist of volcanic rocks. It becomes, therefore, a curious point to speculate on the changes which many of the present islands would undergo, during the lapse of the countless ages, which would be required to elevate them into snow-clad summits. If we take the case of Ascension, or St. Helena, both of which have long existed in an extinct condition, we may feel assured, before so vast a period could elapse, during the whole of which the surface would be exposed to constant wear and tear, that the mere nucleus or core of the island would remain; perhaps, every fragment of cellular rock having been decomposed, a mass of some compact stone, as phonolite or greenstone, would crown our new Chimborazo.

The rocks of St. Paul appear from a distance of a brilliantly white colour. This is partly owing to the dung of a vast multitude of seafowl, and partly to a coating of a glossy white substance, which is intimately united to the surface of the rocks. This, when examined with a lens, is found to consist of numerous exceedingly thin layers, its total thickness being about the tenth of an inch. The surface is smooth

and glossy, and has a pearly lustre; it is considerably harder than calcareous spar, although it can be scratched by a knife: under the blowpipe it decrepitates, slightly blackens, and emits a fetid odour. It consists of phosphate of lime, mingled with some impurities; and its origin without doubt is due to the action of the rain or spray on the bird's dung. I may here mention, that I found in some hollows in the lava rocks of Ascension considerable masses of the substance called *guano*, which on the west coast of the intertropical parts of South America occurs in great beds, some yards thick, on the islets frequented by seafowl. According to the analysis of Fourcroy and Vauquelin, it consists of the urates, phosphates, and oxalates of lime, ammonia, and potash, together with some other salts, and some fatty and earthy matter. I believe there is no doubt of its being the richest manure which has ever been discovered. At Ascension, close to the *guano*, stalactitic or botryoidal masses of impure phosphate of lime adhered to the basalt. The basal part of these had an earthy texture, but the extremities were smooth and glossy, and sufficiently hard to scratch common glass. These stalactites appeared to have shrunk, perhaps from the removal of some soluble matter, in the act of consolidation; and hence they had an irregular form. Similar stalactitic masses,* though I am not aware that they have ever been noticed, are, I believe, by no means of uncommon occurrence.

We only observed two kinds of birds—the booby and the noddy. The former is a species of gannet, and the latter a tern. Both are of a tame and stupid disposition, and are so unaccustomed to visiters, that I could have killed any number of them with my geological hammer. The booby lays her eggs on the bare rock; but the tern makes a very simple nest

* I may mention that I was shown, at Ascension, some very fine stalactites, composed of sulphate of lime, which had been taken out of a cavern. From their external appearance they would generally be mistaken for the ordinary calcareous kind. It was interesting to observe, in a fractured specimen, the double cleavage intersecting with its even planes, the irregular layers of successive deposition.

with sea-weed. By the side of many of these nests a small flying-fish was placed; which, I suppose, had been brought by the male bird for its partner. It was amusing to watch how quickly a large and active crab (*Graspus*), which inhabits the crevices of the rock, stole the fish from the side of the nest, as soon as we had disturbed the birds. Not a single plant, not even a lichen, grows on this island; yet it is inhabited by several insects and spiders. The following list completes, I believe, the terrestrial fauna: a species of Feronia and an acarus, which must have come here as parasites on the birds; a small brown moth, belonging to a genus that feeds on feathers; a staphylinus (*Quedius*) and a woodlouse from beneath the dung; and lastly, numerous spiders, which I suppose prey on these small attendants on, and scavengers of the waterfowl. The often-repeated description of the first colonists of the coral islets in the South Sea, is not, probably, quite correct: I fear it destroys the poetry of the story to find, that these little vile insects should thus take possession before the cocoa-nut tree and other noble plants have appeared.

The smallest rock in the tropical seas, by giving a foundation, for the growth of innumerable kinds of sea-weed and compound animals, supports likewise a large number of fish. The sharks and the seamen in the boats maintained a constant struggle, who should secure the greater share of the prey caught by the lines. I have heard, that a rock near the Bermudas, lying many miles out at sea, and covered by a considerable depth of water, was first discovered by the circumstance of fish having been observed in the neighbourhood.

Fernando Noronha, Feb. 20th.—As far as I was enabled to observe, during the few hours we staid at this place, the constitution of the island is volcanic, but probably not of a recent date. The most remarkable feature is a conical hill, about one thousand feet high, the upper part of which is exceedingly steep, and on one side overhangs its base. The rock is phonolite, and is divided into irregular

columns. From the first impression, on viewing one of these isolated masses, one is inclined to believe, that the whole has been suddenly pushed up in a semi-fluid state. At St. Helena, however, I ascertained that some pinnacles, of a nearly similar figure and constitution, had been formed by the injection of melted rock among the yielding strata; which thus formed the model for these gigantic obelisks. The whole island is covered with wood; but from the dryness of the climate there is no appearance of luxuriance. At some elevation great masses of the columnar rock, shaded by laurels, and ornamented by a tree covered by fine pink flowers like those of a foxglove, but without a single leaf, gave a pleasing effect to the nearer parts of the scenery.

Bahia, or San Salvador. Brazil, Feb. 29th.—The day has past delightfully. Delight itself, however, is a weak term to express the feelings of a naturalist who, for the first time, has been wandering by himself in a Brazilian forest. Among the multitude of striking objects, the general luxuriance of the vegetation bears away the victory. The elegance of the grasses, the novelty of the parasitical plants, the beauty of the flowers, the glossy green of the foliage, all tend to this end. A most paradoxical mixture of sound and silence pervades the shady parts of the wood. The noise from the insects is so loud, that it may be heard even in a vessel anchored several hundred yards from the shore; yet within the recesses of the forest a universal silence appears to reign. To a person fond of natural history, such a day as this, brings with it a deeper pleasure than he ever can hope again to experience. After wandering about for some hours, I returned to the landing-place; but, before reaching it, I was overtaken by a tropical storm. I tried to find shelter under a tree which was so thick, that it would never have been penetrated by common English rain; but here, in a couple of minutes, a little torrent flowed down the trunk. It is to this violence of the rain we must attribute the verdure at the bottom of the thickest woods: if the showers were like those of a colder clime, the greater part would be

absorbed or evaporated before it reached the ground. I will not at present attempt to describe the gaudy scenery of this noble bay, because, in our homeward voyage, we called here a second time, and I shall then have occasion to remark on it.

The geology of the surrounding country possesses little interest. Throughout the coast of Brazil, and certainly for a considerable space inland, from the Rio Plata to Cape St. Roque, lat. 5° S., a distance of more than 2000 geographical miles, wherever solid rock occurs, it belongs to a granitic formation. The circumstance of this enormous area being thus constituted of materials, which almost every geologist believes to have been crystallized by the action of heat under pressure, gives rise to many curious reflections. Was this effect produced beneath the depths of a profound ocean? or did a covering of strata formerly extend over it, which has since been removed? Can we believe that any power, acting for a time short of infinity, could have denuded the granite over so many thousand square leagues?

On a point not far from the city, where a rivulet entered the sea, I observed a fact connected with a subject discussed by Humboldt.* At the cataracts of the great rivers Orinoco, Nile, and Congo, the syenitic rocks are coated by a black substance, appearing as if they had been polished with plumbago. The layer is of extreme thinness; and on analysis by Berzelius it was found to consist of the oxides of manganese and iron. In the Orinoco it occurs on the rocks periodically washed by the floods, and in those parts alone, where the stream is rapid; or, as the Indians say, "the rocks are black, where the waters are white." The coating is here of a rich brown instead of a black colour, and seems to be composed of ferrugineous matter alone. Hand specimens fail to give a just idea of these brown, burnished, stones which glitter in the sun's rays.

* Pers. Narr., vol. v., pt. i., p. 18.

They occur only within the limits of tidal action; and as the rivulet slowly trickles down, the surf must supply the polishing power of the cataracts in the great rivers. In the same manner, the rise and fall of the tide probably answers to the periodical inundations; and thus the same causes are present under apparently very different circumstances. The real origin, however, of these coatings of metallic oxides, which seem as if cemented to the rocks, is not understood; and no reason, I believe, can be assigned for their thickness remaining constant.

One day I was amused by watching the habits of a Diodon, which was caught swimming near the shore. This fish is well known to possess the singular power of distending itself into a nearly spherical form. After having been taken out of water for a short time, and then again immersed in it, a considerable quantity both of water and air was absorbed by the mouth, and perhaps likewise by the branchial apertures. This process is effected by two methods; the air is swallowed, and is then forced into the cavity of the body, its return being prevented by a muscular contraction which is externally visible; but the water, I observed, entered in a stream through the mouth, which was wide open and motionless: this latter action must, therefore, depend on suction. The skin about the abdomen is much looser than that of the back; hence, during the inflation, the lower surface becomes far more distended than the upper; and the fish, in consequence, floats with its back downwards. Cuvier doubts whether the Diodon, in this position, is able to swim; but not only can it thus move forward in a straight line, but likewise it can turn round to either side. This latter movement is effected solely by the aid of the pectoral fins; the tail being collapsed, and not used. From the body being buoyed up with so much air, the branchial openings were out of water; but a stream drawn in by the mouth, constantly flowed through them.

The fish, having remained in this distended state for a

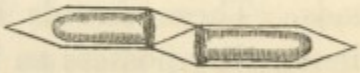
short time, generally expelled the air and water with considerable force from the branchial apertures and mouth. It could emit, at will, a certain portion of the water; and it appears, therefore, probable, that this fluid is taken in partly for the sake of regulating its specific gravity. This diodon possessed several means of defence. It could give a severe bite, and could eject water from its mouth to some distance, at the same time it made a curious noise by the movement of its jaws. By the inflation of its body, the papillæ, with which the skin is covered, became erect and pointed. But the most curious circumstance was, that it emitted from the skin of its belly, when handled, a most beautiful carmine red and fibrous secretion, which stained ivory and paper in so permanent a manner, that the tint is retained with all its brightness to the present day. I am quite ignorant of the nature and use of this secretion.

March 18th.—We sailed from Bahia. A few days afterwards, when not far distant from the Abrolhos islets, my attention was called to a discoloured appearance in the sea. The whole surface of the water, as it appeared under a weak lens, seemed as if covered by chopped bits of hay, with their ends jagged. One of the larger particles measured .03 of an inch in length, and .009 in breadth. Examined more carefully, each is seen to consist of from twenty to sixty cylindrical filaments, which have perfectly rounded extremities, and are divided at regular intervals by transverse septa, containing a brownish-green flocculent matter. The filaments must be enveloped in some viscid fluid, for the bundles adhered together without actual contact. I do not know to what family these bodies properly belong, but they have a close general resemblance in structure with the confervæ which grow in every ditch. These simple vegetables, thus constituted for floating in the open ocean, must in certain places exist in countless numbers. The ship passed through several bands of them, one of which was about ten yards wide, and, judging from the mud-like colour of the

water, at least two and a half miles long. In almost every long voyage some account is given of these confervæ. They appear especially common in the sea near Australia. Off Cape Leeuwin, I found some very similar to those above described; they differed chiefly in the bundles being rather smaller, and being composed of fewer filaments. Captain Cook, in his third voyage, remarks, that the sailors gave to this appearance the name of sea-sawdust.

I may here mention that during two days preceding our arrival at the Keeling Islands in the Indian Ocean, I saw in many parts masses of flocculent matter, of a brownish-green colour, floating in the sea. They varied in size, from half to to three or four inches square; and were quite irregular in figure. In an opake vessel they could barely be distinguished, but in a glass one they were clearly visible. Under the microscope the flocculent matter was seen to consist of two kinds of confervæ, between which I am quite ignorant whether there exists any connexion. Minute cylindrical bodies, conical at each extremity, are involved in vast numbers, in a mass of fine threads. These threads have a diameter of about $\frac{2}{3000}$ of an inch; they possess an internal lining, and are divided at irregular and very wide intervals by transverse septa. Their length is so great, that I could never with certainty ascertain the form of the uninjured extremity; they are all curvilinear, and resemble in mass a handful of hair, coiled up and squeezed together. In the midst of these threads, and probably connected by some viscid fluid, the other kind, or the cylindrical transparent bodies, float in great numbers. These have their two extremities terminated by cones, produced into the finest points: their diameter is tolerably constant between .006 and .008 of an inch; but their length varies considerably from .04 to .06, and even sometimes to .08. Near one extremity of the cylindrical part, a green septum, formed of granular matter, and thickest in the middle, may generally be seen. This, I believe, is the bottom of a most delicate, colourless sack, composed of a pulpy substance, which lines the exterior case, but does

not extend within the extreme conical points. In some, small but perfect spheres of brownish granular matter supplied the place of the septa; and I observed the curious process by which they were produced. The pulpy matter of the internal coating suddenly grouped itself into lines, some of which assumed a form radiating from a common centre; it then continued, with an irregular and rapid movement, to contract itself, so that, in the course of a second, the whole was united into a perfect little sphere, which occupied the position of the septum at one end of the now quite hollow case. The appearance was as if an elastic membrane, for instance a thin Indian-rubber ball, had been distended with air, and then burst, in which case the edges would instantly shrink up and contract towards a point. The formation of the granular sphere was hastened by any accidental injury. I may add, that frequently a pair of these bodies were attached to each other, as represented in the accompanying rude drawing, cone beside



cone, at that end where the septum occurs. When floating uninjured in the sea, the formation of the spherical gemmules perhaps only takes place, when two of the plants (or rather animals, according to Bory St. Vincent) thus become attached, and married to each other. Nevertheless, I certainly witnessed this curious process in several individuals, when separate, and where there was no apparent cause of disturbance. In any case it does not seem probable, from the fixed structure of the septum, that the whole of the granular matter is transferred from one to the other body, as with the true Conjugatæ.

I will here add a few other observations connected with the discoloration of the sea from organic causes. On the coast of Chile, a few leagues north of Concepcion, the Beagle one day passed through great bands of muddy water; and

again, a degree south of Valparaiso, the same appearance was still more extensive. Although we were nearly fifty miles from the coast, I at first attributed this circumstance to real streams of muddy water brought down by the river Maypo. Mr. Sulivan, however, having drawn up some in a glass, thought he distinguished, by the aid of a lens, moving points. The water was slightly stained as if by red dust; and after leaving it for some time quiet, a cloud collected at the bottom. With a lens, of one-fourth of an inch focal distance, small hyaline points could be seen darting about with great rapidity, and frequently exploding. Examined with a much higher power, their shape was found to be oval, and contracted by a ring round the middle, from which line curved little setæ proceeded on all sides; and these were the organs of motion. One end of the body was narrower and more pointed than the other. According to the arrangement of Bory St. Vincent, they are animalcula, belonging to the family of Trichodes: it was, however, very difficult to examine them with care, for almost the instant motion ceased, even while crossing the field of vision, their bodies burst. Sometimes both ends burst at once, sometimes only one, and a quantity of coarse brownish granular matter was ejected, which cohered very slightly. The ring with the setæ sometimes retained its irritability for a little while after the contents of the body had been emptied, and continued a riggling, uneven motion. The animal an instant before bursting expanded to half again its natural size; and the explosion took place about fifteen seconds after the rapid progressive motion had ceased: in a few cases it was preceded for a short interval by a rotatory movement on the longer axis. About two minutes after any number were isolated in a drop of water, they thus perished. The animals move with the narrow apex forwards, by the aid of their vibratory ciliæ, and generally by rapid starts. They are exceedingly minute, and quite invisible to the naked eye, only covering a space equal to the square of the thousandth of an inch. Their numbers were infinite; for the smallest

drop of water which I could remove contained very many. In one day we passed through two spaces of water thus stained, one of which alone must have extended over several square miles. What incalculable numbers of these microscopical animals! The colour of the water, as seen at some distance, was like that of a river which has flowed through a red clay district; but under the shade of the vessel's side, it was quite as dark as chocolate. The line where the red and blue water joined was distinctly defined. The weather for some days previously had been calm, and the ocean abounded, to an unusual degree, with living creatures. In Ulloa's voyage an account is given of crossing, in nearly the same latitude, some discoloured water, which was mistaken for a shoal: no soundings were obtained, and I have no doubt, from the description, that this little animalcule was the cause of the alarm.*

In the sea around Tierra del Fuego, and at no great distance from the land, I have seen narrow lines of water of a bright red colour, from the number of crustacea, which somewhat resemble in form large prawns. The sealers call them whale-food. Whether whales feed on them I do not know; but terns, cormorants, and immense herds of great unwieldly seals, on some parts of the coast, derive their chief sustenance from these swimming crabs. Seamen invariably attribute the discoloration of the water to spawn; but I found this to be the case only on one occasion. At the distance of several leagues from the Archipelago of the Galapagos, the ship sailed through three strips of a dark yel-

* M. Lesson (Voyage de la Coquille, vol. i., p. 255) mentions red water off Lima, apparently produced by the same cause. Peron, the distinguished naturalist, in the "Voyage Aux Terres Australes," gives no less than twelve references to voyagers who have alluded to the discoloured waters of the sea (vol. ii., p. 239). It was his intention to have written an essay on the subject. To the references given by Peron may be added, Humboldt's Pers. Narr., vol. vi., p. 804; Flinder's Voyage, vol. i., p. 92; Labillardiere, vol. i., p. 287; Ulloa's Voyage; Voyage of the Astrolabe and of the Coquille; Captain King's Survey of Australia, &c.

lowish, or mud-like, water; these strips were some miles long, but only a few yards wide, and they were separated from the surrounding surface by a sinuous yet distinct margin. The colour was caused by little gelatinous balls, about the fifth of an inch in diameter, in which numerous minute spherical ovules were embedded: they were of two distinct kinds, one being of a reddish colour and of a different shape from the other. I cannot form a conjecture as to what two kinds of animals these belonged. Captain Colnett remarks, that this appearance is very common among the Galapagos Islands, and that the direction of the bands indicates that of the currents; in the described case, however, the line was caused by the wind. The only other appearance which I have to notice, is a thin oily coat on the surface which displays iridescent colours. I saw a considerable tract of the ocean thus covered on the coast of Brazil; the seamen attributed it to the putrefying carcass of some whale, which probably was floating at no great distance. I do not here mention the minute gelatinous particles which are frequently dispersed throughout the water, for they are not sufficiently abundant to create any change of colour.

There are two circumstances in the above accounts which appear very remarkable: first, how do the various bodies which form the bands with defined edges keep together? In the case of the prawn-like crabs, their movements were as coinstantaneous as in a regiment of soldiers; but this cannot happen from any thing like voluntary action with the ovules, or the confervæ, nor is it probable among the infusoria. Secondly, what causes the length and narrowness of the bands? The appearance so much resembles that which may be seen in every torrent, where the stream uncoils into long streaks, the froth collected in the eddies, that I must attribute the effect to a similar action either of the currents of the air, or sea. Under this supposition we must believe that the various organized bodies are produced in certain favourable places, and are thence removed by the set of either wind or water. I confess,

however, there is a very great difficulty in imagining any one spot to be the birthplace of the millions of millions of animalcula and confervæ: for whence come the germs at such points?—the parent bodies having been distributed by the winds and waves over the immense ocean. But on no other hypothesis can I understand their linear grouping. I may add that Scoresby remarks, that green water abounding with pelagic animals, is invariably found in a certain part of the Arctic Sea.

CHAPTER II.

Rio de Janeiro—Excursion north of Cape Frio—Great evaporation—Slavery—Botofogo Bay—Terrestrial Planariæ—Clouds on Corcovado—Heavy rain—Musical Hyla—Lampyris and its larvæ—Elater, springing powers—Blue haze—Noise of butterfly—Entomology—Ants—Wasp-killing spider—Parasitical spider—Artifices of Epeira—Gregarious spider—Spider with imperfect web.

RIO DE JANEIRO.

April 4th to July 5th, 1832.- A few days after our arrival I became acquainted with an Englishman who was going to visit his estate situated, rather more than a hundred miles from the capital, to the northward of Cape Frio. As I was quite unused to travelling, I gladly accepted his kind offer of allowing me to accompany him.

April 8th.—Our party amounted to seven. The first stage was very interesting. The day was powerfully hot, and as we passed through the woods, every thing was motionless, excepting the large and brilliant butterflies, which lazily fluttered about. The view seen when crossing the hills behind Praia Grande was most beautiful; the colours were intense, and the prevailing tint a dark blue; the sky and the calm waters of the bay vied with each other in splendour. After passing through some cultivated country, we entered a forest, which in the grandeur of all its parts could not be exceeded. We arrived by midday at Ithacaia; this small village is situated on a plain, and round the central house are the huts of the negroes. These, from their regular form and position, reminded me of the drawings of the Hottentot habitations in Southern Africa. As the moon rose early, we determined to start the same evening for our sleeping-place at the Lagoa Marica. As it was growing

dark we passed under one of the massive, bare, and steep hills of granite which are so common in this country. This spot is notorious from having been, for a long time, the residence of some runaway slaves, who, by cultivating a little ground near the top, contrived to eke out a subsistence. At length they were discovered, and a party of soldiers being sent, the whole were seized with the exception of one old woman, who sooner than again be led into slavery, dashed herself to pieces from the summit of the mountain. In a Roman matron this would have been called the noble love of freedom: in a poor negress it is mere brutal obstinacy. We continued riding for some hours. For the few last miles the road was intricate, and it passed through a desert waste of marshes and lagoons. The scene by the dimmed light of the moon was most desolate. A few fireflies flitted by us; and the solitary snipe, as it rose, uttered its plaintive cry. The distant and sullen roar of the sea scarcely broke the stillness of the night.

April 9th.—We left our miserable sleeping-place before sunrise. The road passed through a narrow sandy plain, lying between the sea and the interior salt lagoons. The number of beautiful fishing birds, such as egrets and cranes, and the succulent plants assuming most fantastical forms, gave to the scene an interest which it would not otherwise have possessed. The few stunted trees were loaded with parasitical plants, among which the beauty and delicious fragrance of some of the orchideæ were most to be admired. As the sun rose, the day became extremely hot, and the reflection of the light and heat from the white sand was very distressing. We dined at Mandetiba; the thermometer in the shade being 84°. The beautiful view of the distant wooded hills, reflected in the perfectly calm water of an extensive lagoon, quite refreshed us. As the vênda* here was a very good one, and I have the pleasant, but rare remembrance, of an excellent dinner, I will be grateful and presently describe

* Vênda, the Portuguese name for an inn.

it, as the type of its class. These houses are often large, and are built of thick upright posts, with boughs interwoven, and afterwards plastered. They seldom have floors, and never glazed windows; but are generally pretty well roofed. Universally the front part is open, forming a kind of verandah, in which tables and benches are placed. The bed-rooms join on each side, and here the passenger may sleep as comfortably as he can, on a wooden platform, covered by a thin straw mat. The vênda stands in a courtyard, where the horses are fed. On first arriving, it was our custom to unsaddle the horses and give them their Indian corn; then, with a low bow, to ask the senhôr to do us the favour to give us something to eat. "Any thing you choose, sir," was his usual answer. For the few first times, vainly I thanked Providence for having guided us to so good a man. The conversation proceeding, the case universally became deplorable. "Any fish can you do us the favour of giving?"—"Oh! no, sir."—"Any soup?"—"No, sir."—"Any bread?"—"Oh! no, sir."—"Any dried meat?"—"Oh! no, sir." If we were lucky, by waiting a couple of hours, we obtained fowls, rice, and farinha. It not unfrequently happened, that we were obliged to kill, with stones, the poultry for our own supper. When thoroughly exhausted by fatigue and hunger, we timorously hinted that we should be glad of our meal, the pompous, and (though true) most unsatisfactory answer was, "It will be ready when it is ready." If we had dared to remonstrate any further, we should have been told to proceed on our journey, as being too impertinent. The hosts are most ungracious and disagreeable in their manners; their houses and their persons are often filthily dirty; the want of the accommodation of forks, knives, and spoons is common; and I am sure no cottage or hovel in England could be found in a state so utterly destitute of every comfort. At Campos Novos, however, we fared sumptuously; having rice and fowls, biscuit, wine, and spirits, for dinner; coffee in the evening, and fish with coffee for breakfast. All this, with good food for the

horses, only cost 2*s.* 6*d.* per head. Yet the host of this vênda, being asked if he knew any thing of a whip which one of the party had lost, gruffly answered, "How should I know? why did you not take care of it?—I suppose the dogs have eat it."

Leaving Mandetiba, we continued to pass through an intricate wilderness of lakes; in some of which were fresh, in others salt water shells. Of the former kind I found a Limnæa in great numbers in a lake, into which, the inhabitants assured me, the sea annually, and sometimes oftener, entered, and made the water quite salt. I have no doubt many interesting facts, in relation to marine and fresh water animals, might be observed in this chain of lagoons, which skirt the coast of Brazil. M. Gay* has stated that he found in the neighbourhood of Rio, shells of the marine genera solen and mytilus, and fresh water ampullariæ, living together in brackish water. I also frequently observed in the lagoon near the Botanic Garden, where the water is only a little less salt than in the sea, a species of hydrophilus, very similar to a species common in the ditches of England: in the same lake the only shell belonged to a genus generally found in estuaries.

Leaving the coast for a time, we again entered the forest. The trees were very lofty, and remarkable, compared to those of Europe, from the whiteness of their trunks. I see by my note-book, "wonderful and beautiful, flowering parasites," invariably struck me as the most novel object in these grand scenes. Travelling onwards we passed through tracts of pasturage, much injured by the enormous conical ants' nests, which were nearly twelve feet high. They gave to the plain exactly the appearance of the mud volcanoes at Jorullo, as figured by Humboldt. We arrived at Engenhodo after it was dark, having been ten hours on horseback. I never ceased, during the whole journey, to be surprised at the amount of labour which the horses were capable of enduring;

* Annales des Sciences Naturelles for 1833.

they appeared also to recover from any injury much sooner than those of our English breed. The Vampire bat is often the cause of much trouble, by biting the horses on their withers. The injury is generally not so much owing to the loss of blood, as to the inflammation which the pressure of the saddle afterwards produces. The whole circumstance has lately been doubted in England; I was therefore fortunate in being present when one* was actually caught on a horse's back. We were bivouacking late one evening near Coquimbo, in Chile, when my servant, noticing that one of the horses was very restive, went to see what was the matter, and fancying he could distinguish something, suddenly put his hand on the beast's withers, and secured the vampire. In the morning, the spot, where the bite had been inflicted, was easily distinguished from being slightly swollen and bloody. The third day afterwards we rode the horse, without any ill effects.

April 13th.—After three days' travelling we arrived at Socêgo, the estate of Senhôr Manuel Figuireda, a relation of one of our party. The house was simple, and, though like a barn in form, was well suited to the climate. In the sitting-room gilded chairs and sofas were oddly contrasted with the whitewashed walls, thatched roof, and windows without glass. The house, together with the granaries, the stables, and workshops for the blacks, who had been taught various trades, formed a rude kind of quadrangle; in the centre of which a large pile of coffee was drying. These buildings stand on a little hill, overlooking the cultivated ground, and surrounded on every side by a wall of dark green luxuriant forest. The chief produce of this part of the country is coffee. Each tree is supposed to yield annually, on an average, two pounds; but some give as much as eight. Mandioca or cassada is likewise cultivated in great quantity. Every part of this plant is useful: the leaves and stalks are

* This bat belongs to the genus Edostoma of D'Orbigny, but is a new species.

eaten by the horses, and the roots are ground into a pulp, which, when pressed dry and baked, forms the farinha, the principal article of sustenance in the Brazils. It is a curious, though well-known fact, that the expressed juice of this most nutritious plant is highly poisonous. A few years ago a cow died at this Fazênda, in consequence of having drunk some of it. Senhôr Figuireda told me that he had planted, the year before, one bag of feijaô or beans, and three of rice; the former of which produced eighty, and the latter three hundred and twenty fold. The pasturage supports a fine stock of cattle, and the woods are so full of game, that a deer had been killed on each of the three previous days. This profusion of food showed itself at dinner, where, if the tables did not groan, the guests surely did: for each person is expected to eat of every dish. One day, having, as I thought, nicely calculated so that nothing should go away untasted, to my utter dismay a roast turkey and a pig appeared in all their substantial reality. During the meals, it was the employment of a man to drive out of the room sundry old hounds, and dozens of little black children, which crawled in together, at every opportunity. As long as the idea of slavery could be banished, there was something exceedingly fascinating in this simple and patriarchal style of living: it was such a perfect retirement and independence of the rest of the world. As soon as any stranger is seen arriving, a large bell is set tolling, and generally some small cannon are fired. The event is thus announced to the rocks and woods, but to nothing else. One morning I walked out an hour before daylight to admire the solemn stillness of the scene; at last, the silence was broken by the morning hymn, raised on high by the whole body of the blacks; and in this manner, their daily work is generally begun. On such fazendas as these, I have no doubt the slaves pass happy and contented lives. On Saturday and Sunday they work for themselves, and in this fertile climate the labour of two days is sufficient to support a man and his family for the whole week.

April 14th.—Leaving Socêgo, we rode to another estate on the Rio Macâe, which was the last patch of cultivated ground in that direction. The estate was two and a half miles long, and the owner had forgotten how many broad. Only a very small piece had been cleared, yet almost every acre was capable of yielding all the various rich productions of a tropical land. Considering the enormous area of Brazil, the proportion of cultivated ground can scarcely be considered as any thing, compared to that which is left in the state of nature: at some future age, how vast a population it will support! During the second day's journey we found the road so shut up, that it was necessary that a man should go ahead with a sword to cut away the creepers. The forest abounded with beautiful objects; among which the tree ferns, though not large, were, from their bright green foliage, and the elegant curvature of their fronds, most worthy of admiration. In the evening it rained very heavily, and although the thermometer stood at 65°, I felt very cold. As soon as the rain ceased, it was curious to observe the extraordinary evaporation which commenced over the whole extent of the forest. At the height of a hundred feet the hills were buried in a dense white vapour, which rose like columns of smoke from the most thickly-wooded parts, and especially from the valleys. I observed this phenomenon on several occasions: I suppose it is owing to the large surface of foliage, previously heated by the sun's rays.

While staying at this estate, I was very nearly being an eyewitness to one of those atrocious acts, which can only take place in a slave country. Owing to a quarrel and a lawsuit, the owner was on the point of taking all the women and children from the men, and selling them separately at the public auction at Rio. Interest, and not any feeling of compassion, prevented this act. Indeed, I do not believe the inhumanity of separating thirty families, who had lived together for many years, even occurred to the person. Yet I will pledge myself, that in humanity and good feeling, he

was superior to the common run of men. It may be said there exists no limit to the blindness of interest and selfish habit. I may mention one very trifling anecdote, which at the time struck me more forcibly than any story of cruelty. I was crossing a ferry with a negro, who was uncommonly stupid. In endeavouring to make him understand, I talked loud, and made signs, in doing which I passed my hand near his face. He, I suppose, thought I was in a passion, and was going to strike him; for instantly, with a frightened look and half-shut eyes, he dropped his hands. I shall never forget my feelings of surprise, disgust, and shame, at seeing a great powerful man afraid even to ward off a blow, directed, as he thought, at his face. This man had been trained to a degradation lower than the slavery of the most helpless animal.

April 18th.—In returning we spent two days at Socêgo, and I employed them in collecting insects in the forest. The greater number of trees, although so lofty, are not more than three or four feet in circumference. There are, of course, a few of much greater dimension. Senhor Manuel, was then making a canoe seventy feet in length from a solid trunk, which had originally been 110 feet long, and of great thickness. The contrast of palm-trees, growing amidst the common branching kinds, never fails to give the scene an intertropical character. Here the woods were ornamented by the Cabbage Palm—one of the most beautiful of its family. With a stem so narrow that it might be clasped with the two hands, it waves its elegant head at the height of forty or fifty feet above the ground. The woody creepers, themselves covered by other creepers, were of great thickness: some which I measured were two feet in circumference. Many of the older trees presented a very curious appearance from the tresses of a liana depending from their boughs, and resembling bundles of hay. If the eye was turned from the world of foliage above, to the ground beneath, it was attracted by the extreme elegance of the leaves of the ferns

and mimosæ. The latter, in some parts, covered the surface with a brushwood only a few inches high. In walking across these thick beds, a broad track was marked by the change of shade, produced by the drooping of their sensitive petioles. It is easy to specify the individual objects of admiration in these grand scenes; but it is not possible to give an adequate idea of the higher feelings of wonder, astonishment, and devotion, which fill and elevate the mind.

April 19th.—Leaving Socêgo, during the two first days, we retraced our steps. It was very wearisome work, as the road generally ran across a glaring hot sandy plain, not far from the coast. I noticed that each time the horse put its foot on the fine siliceous sand, a gentle chirping noise was produced. On the third day we took a different line, and passed through the gay little village of Madre de Deos. This is one of the principal lines of road in Brazil; yet it was in so bad a state, that no wheel vehicle, excepting the clumsy bullock-waggon, could pass along. In our whole journey we did not cross a single bridge built of stone; and those made of logs of wood were frequently so much out of repair, that it was necessary to go on one side to avoid them. All distances are inaccurately known. The road is often marked by crosses, in the place of milestones, to signify where human blood has been spilled. On the evening of the 23d we arrived at Rio, having finished our pleasant little excursion.

During the remainder of my stay at Rio, I resided in a cottage at Botofogo Bay. It was impossible to wish for any thing more delightful than thus to spend some weeks in so magnificent a country. In England any person fond of natural history enjoys in his walks a great advantage, by always having something to attract his attention; but in these fertile climates, teeming with life, the attractions are so numerous, that he is scarcely able to walk at all.

The few observations which I was enabled to make were almost exclusively confined to the invertebrate animals. The

existence of a division of the genus Planaria, which inhabits the dry land, interested me much. These animals are of so simple a structure, that Cuvier has arranged them with the intestinal worms, though never found within the bodies of other animals. Numerous species inhabit both salt and fresh water; but those to which I allude were found beneath logs of rotten wood, even in the drier parts of the forest. In general form they resemble little slugs, but are very much narrower in proportion. I met with one specimen no less than five inches long. The lower surface, by which they crawl, is flat, the upper being convex: in this latter respect the terrestrial species all differ from the depressed forms of the aquatic. Their structure is very simple. Near the middle of the under surface, there are two small transverse slits, from the anterior one of which a funnel-shaped organ, or cup, can be protruded. This seems to act as the mouth. It is soft, highly irritable, and capable of various movements; when drawn within the body it is generally folded up like the bud of a plant. From the central position of the orifice, the animal has its mouth in the middle of what would commonly be called its stomach! For some time after the rest of the animal has become dead from the effects of salt water, or other cause, this organ still retains its vitality. The body is soft and parenchymatous; in the central part a transparent space, with lateral ramifications, appears to act as a system of circulation. Minute, black, eye-like specks are scattered round the margin of the crawling surface, and more abundantly close to the anterior extremity, which is constantly used as a feeler. In a marine species, I extracted from the central parts of the body vast numbers of little spherical eggs; they were .006 of an inch in diameter, and contained a central opake mass or yolk.

The terrestrial Planariæ, of which I have found no less than eight species, occur from within the tropic to lat. 47° south, and are common to South America, New Zealand, Van Diemen's Land, and Mauritius. Some of the species

are longitudinally striped with several bands of gay colours. At first sight there is a remarkable false analogy between these animals and snails, although so widely separated from each other in all essential points of organization. I suppose these Planariæ feed on rotten wood, for they are always found crawling on the under surface of old decayed trees; and some small specimens being kept with no other food, rapidly increased in size. Although gaily-coloured little animals, they dislike, and are very sensitive to the light. Some specimens which I obtained at Van Diemen's Land, I kept alive for nearly two months. Having cut one of them transversely into two nearly equal parts, in the course of a fortnight both had the shape of perfect animals. I had, however, so divided the body, that one of the halves contained both the inferior orifices, and the other, in consequence, none. In the course of twenty-five days from the operation, the more perfect half could not have been distinguished from any other specimen. The other had increased much in size; and towards its posterior end, a clear space was formed in the parenchymatous mass, in which a rudimentary cup-shaped organ could clearly be distinguished; on the under surface, however, no corresponding slit was yet open. If the increased heat of the weather, as we approached the equator, had not destroyed all the individuals, there can be no doubt that this last step would have completed its structure. Although so well-known an experiment, it was interesting to watch the gradual production of every essential organ, out of the simple extremity of another animal. It is extremely difficult to preserve these Planariæ; immediately the cessation of life allows the ordinary laws of change to act, their entire bodies become soft and fluid, with a rapidity which I have never seen equalled. A method of preservation that I found answered pretty well, was to dry the whole animal rapidly on a thin plate of mica, for the body thus becomes transparent, and allows the internal structure to be seen.

I first visited the forest in which these Planariæ were

found, in company with an old Portuguese priest who took me out to hunt with him. The sport consisted in turning into the cover a few dogs, and then patiently waiting to fire at any animal which might appear. We were accompanied by the son of a neighbouring farmer—a good specimen of a wild Brazilian youth. He was dressed in a tattered old shirt and trousers, and had his head uncovered: he carried an old-fashioned gun and a large knife. The habit of carrying the knife is universal; and in traversing a thick wood it is almost necessary, on account of the creeping plants. The frequent occurrence of murder may be partly attributed to this habit. The Brazilians are so dexterous with the knife, that they can throw it to some distance with precision, and with sufficient force to cause a fatal wound. I have seen a number of little boys practising this art as a game of play, and from their skill in hitting an upright stick, they promised well for more earnest attempts. My companion, the day before, had shot two large bearded monkeys. These animals have prehensile tails, the extremity of which, even after death, can support the whole weight of the body. One of them thus remained fast to a branch, and it was necessary to cut down a large tree to procure it. This was soon effected, and down came tree and monkey with an awful crash. Our day's sport, besides the monkey, was confined to sundry small green parrots and a few toucans. I profited, however, by my acquaintance with the Portuguese padre, for on another occasion he gave me a fine specimen of the Yaguarundi cat.

Every one has heard of the beauty of the scenery near Botofogo. The house in which I lived was seated close beneath the well-known mountain of the Corcovado. It has been remarked, with much truth, that abruptly conical hills are characteristic of the formation which Humboldt designates as gneiss-granite. Nothing can be more striking than the effect of these huge rounded masses of naked rock rising out of the most luxuriant vegetation.

I was often interested by watching the clouds, which,

rolling in from seaward, formed a bank just beneath the highest point of the Corcovado. This mountain, like most others, when thus partly veiled, appeared to rise to a far prouder elevation than its real height of 2300 feet. Mr. Daniell has observed, in his meteorological essays, that a cloud sometimes appears fixed on a mountain summit, while the wind continues to blow over it. The same phenomenon here presented a slightly different appearance. In this case the cloud was clearly seen to curl over, and rapidly pass by the summit, and yet was neither diminished nor increased in size. The sun was setting, and a gentle southerly breeze, striking against the southern side of the rock, mingled its current with the colder air above; and the vapour was thus condensed: but as the light wreaths of cloud passed over the ridge, and came within the influence of the warmer atmosphere of the northern sloping bank, they were immediately redissolved.

The climate, during the months of May and June, or the beginning of winter, was delightful. The mean temperature, from observations taken at nine o'clock, both morning and evening, was only 72°. It often rained heavily, but the drying southerly winds soon again rendered the walks pleasant. One morning, in the course of six hours, 1.6 inches of rain fell. As this storm passed over the forests, which surround the Corcovado, the sound produced by the drops pattering on the countless multitude of leaves, was very remarkable; it could be heard at the distance of a quarter of a mile, and was like the rushing of a great body of water. After the hotter days, it was delicious to sit quietly in the garden and watch the evening pass into night. Nature, in these climes, chooses her vocalists from more humble performers than in Europe. A small frog, of the genus Hyla,* sits on a blade of glass about an inch above the surface of the

* I had some difficulty in catching a specimen of this frog. The genus Hyla has its toes terminated by small suckers; and I found this animal could crawl up a pane of glass, when placed absolutely perpendicular.

water, and sends forth a pleasing chirp. When several were together they sung in harmony on different notes. Various cicadæ and crickets, at the same time, kept up a ceaseless shrill cry, but which, softened by the distance, was not unpleasant. Every evening after dark this great concert commenced; and often have I sat listening to it, until my attention has been drawn away by some curious passing insect.

At these times the fireflies are seen* flitting about from hedge to hedge. All that I caught belonged to the family of Lampyridæ, or glowworms, and the greater number were *Lampyris occidentalis.* I found that this insect emitted the most brilliant flashes when irritated: in the intervals the abdominal rings were obscured. The flash was almost coinstantaneous in the two rings, but it was first just perceptible in the anterior one. The shining matter was fluid and very adhesive: little spots, where the skin had been torn, continued bright with a slight scintillation, whilst the uninjured parts were obscured. When the insect was decapitated the rings remained uninterruptedly bright, but not so brilliant as before: local irritation with a needle always increased the vividness of the light. The rings in one instance retained their luminous property nearly twenty-four hours after the death of the insect. From these facts it would appear probable, that the animal has only the power of concealing or extinguishing the light for short intervals, and that at other times the display is involuntary. On the muddy and wet gravel-walks I found the larvæ of this lampyris in great numbers: they resembled in general form the female of the English glowworm. These larvæ possessed but feeble luminous powers; very differently from their parents, on the slightest touch they feigned death, and ceased to shine; nor did irritation excite any fresh display. I kept several of them alive for

* On a dark night the light could be seen at about two hundred paces distant. It is remarkable that in all the glowworms, shining elaters, and various marine animals, which I have observed (such as the crustacea, medusæ, nereidæ, a coralline of the genus Clytia, and Pyrosoma), the light has been of a well-marked green colour.

some time: their tails are very singular organs, for they act, by a well-fitted contrivance, as suckers, or organs of attachment, and likewise as reservoirs for saliva, or some such fluid. I repeatedly fed them on raw meat; and I invariably observed, that every now and then the extremity of the tail was applied to the mouth, and a drop of fluid exuded on the meat, which was then in the act of being consumed. The tail, notwithstanding so much practice, does not seem to be able to find its way to the mouth; at least the neck was always touched first, and apparently as a guide.

When we were at Bahia, an elater (*Pyrophorus luminosus*, Illig.) seemed the most common luminous insect. The light in this case was also rendered more brilliant by irritation. I amused myself one day by observing the springing powers of this insect, which have not,* as it appears to me, been properly described. The elater, when placed on its back and preparing to spring, moved its head and thorax backwards, so that the pectoral spine was drawn out, and rested on the edge of its sheath. The same backward movement being continued, the spine, by the full action of the muscles, was bent like a spring; and the insect at this moment rested on the extremity of its head and elytra. The effort being suddenly relaxed, the head and thorax flew up, and, in consequence, the base of the elytra struck the supporting surface with such force, that the insect by the reaction was jerked upwards to the height of one or two inches. The projecting points of the thorax, and the sheath of the spine, served to steady the whole body during the spring. In the descriptions which I have read, sufficient stress does not appear to have been laid on the elasticity of the spine: so sudden a spring could not be the result of simple muscular contraction, without the aid of some mechanical contrivance.

On several occasions I enjoyed some short but most pleasant excursions in the neighbouring country. One day

* Kirby's Entomology, vol. ii., p. 317.

I went to the Botanic Garden, where many plants, well known for their great utility, might be seen growing. The leaves of the camphor, pepper, cinnamon, and clove trees were delightfully aromatick; and the bread fruit, the jack, and the mango, vied with each other in the magnificence of their foliage. The landscape in the neighbourhood of Bahia almost takes its character from the two latter trees. Before seeing them, I had no idea that any trees could cast so black a shade on the ground. Both of them bear to the ever green vegetation of these climates, the same kind of relation which laurels and hollies in England do to the lighter green of the deciduous trees. It may be observed, that the houses within the tropics are surrounded by the most beautiful forms of vegetation, because many of them are at the same time most useful to man. Who can doubt that these qualities are united in the banana, the cocoa-nut, the many kinds of palm, the orange, and the bread-fruit tree?

During this day I was particularly struck with a remark of Humboldt's, who often alludes to "the thin vapour which, without changing the transparency of the air, renders its tints more harmonious, softens its effects," &c. This is an appearance which I have never observed in the temperate zones. The atmosphere, seen through a short space of half or three-quarters of a mile, was perfectly lucid, but at a greater distance all colours were blended into a most beautiful haze, of a pale French gray, mingled with a little blue. The condition of the atmosphere between the morning and about noon, when the effect was most evident, had undergone little change, excepting in its dryness. In the interval, the difference between the dew point and temperature had increased from 7°.5 to 17°.

On another occasion I started early and walked to the Gavia, or topsail mountain. The air was delightfully cool and fragrant; and the drops of dew still glittered on the leaves of the large liliaceous plants, which shaded the streamlets of clear water. Sitting down on a block of granite, it was delightful to watch the various insects and birds as they

flew past. The humming-birds seem particularly fond of such shady retired spots. Whenever I saw these little creatures buzzing round a flower, with their wings vibrating so rapidly as to be scarcely visible, I was reminded of the sphinx moths: their movements and habits are indeed, in many respects, very similar.

Following a pathway I entered a noble forest, and from a height of five or six hundred feet, one of those splendid views was presented, which are so common on every side of Rio. At this elevation the landscape has attained its most brilliant tint; and every form, every shade, so completely surpasses in magnificence all that the European has ever beheld in his own country, that he knows not how to express his feelings. The general effect frequently recalled to my mind the gayest scenery of the Opera-house or the great theatres. I never returned from these excursions empty-handed. This day I found a specimen of a curious fungus, called Hymenophallus. Most people know the English Phallus, which in autumn taints the air with its odious smell: this, however, as the entomologist is aware, is to some of our beetles a delightful fragrance. So was it here; for a Strongylus, attracted by the odour, alighted on the fungus as I carried it in my hand. We here see in two distant countries a similar relation between plants and insects of the same families, though the species of both are different. When man is the agent in introducing into a country a new species, this relation is often broken: as one instance of this I may mention, that the leaves of the cabbages and lettuces, which in England afford food to such a multitude of slugs and caterpillars, in the gardens near Rio are untouched.

During our stay in Brazil I made a large collection of insects. A few general observations on the comparative importance of the different orders, may be interesting to the English entomologist. The large and brilliantly-coloured Lepidoptera bespeak the zone they inhabit, far more plainly than any other race of animals. I allude only to the butterflies; for the moths, contrary to what might have been expected from the rankness of the vegetation, certainly appeared in much

fewer numbers than in our own temperate regions. I was much surprised at the habits of *Papilio feronia*. This butterfly is not uncommon, and generally frequents the orange-groves. Although a high flier, yet it very frequently alights on the trunks of trees. On these occasions its head is invariably placed downwards; and its wings are expanded in a horizontal plane, instead of being folded vertically, as is commonly the case. This is the only butterfly which I have ever seen that uses its legs for running. Not being aware of this fact, the insect, more than once, as I cautiously approached with my forceps, shuffled on one side just as the instrument was on the point of closing, and thus escaped. But a far more singular fact, is the power which this species possesses of making a noise.* Several times when a pair, probably male and female, were chasing each other in an irregular course, they passed within a few yards of me; and I distinctly heard a clicking noise, similar to that produced by a toothed wheel passing under a spring catch.† The noise was continued at short intervals, and could be distinguished at about twenty yards distance. I cannot form a conjecture how it is produced; but I am certain there is no error in the observation.

I was disappointed in the general aspect of the Coleoptera. The number of minute and obscurely-coloured beetles is exceedingly great.* The cabinets of Europe can, as yet, boast

* I find in Langsdorff's travels (in the years 1803-7, p. 74), it is said, that in the island of St. Catherine's, on the coast of Brazil, a butterfly called Februa Hoffmanseggi, makes a noise, when flying away, like a rattle.

† Mr. Waterhouse has had the kindness to examine this butterfly, but cannot discover any mechanism by which the noise is produced.

* I may mention, as a common instance of one day's (June 23d) collecting, when I was not attending particularly to the Coleoptera, that I caught sixty-eight species of that order. Among these, there were only two of the Carabidæ, four Brachelytra, fifteen Rhyncophora, and fourteen of the Chrysomelidæ. Thirty-seven species of Arachnidæ, which I brought home, will be sufficient to prove that I was not paying overmuch attention to the generally favoured order of Coleoptera.

only of the larger species from tropical climates. It is sufficient to disturb the composure of an entomologist's mind, to look forward to the future dimensions of a complete catalogue. The Carabidæ appear in extremely few numbers within the tropics. This is the more remarkable when compared to the opposed case of the carnivorous mammalia, an order which they certainly represent among insects. I was struck with this observation both on entering Brazil, and when I saw the elegant and active forms of the Harpalidæ reappearing on the temperate plains of La Plata. Do the very numerous Arachnidæ and rapacious Hymenoptera supply the place of these carnivorous beetles? The carrion-feeders and Brachelytra are very uncommon; on the other hand, the Rhyncophora and Chrysomelidæ, all of which depend on the vegetable world for subsistence, are present in astonishing numbers. I do not here refer to the number of different species, but to that of the individual insects; for on this it is that the most striking character in the entomology of different countries depends. The orders Orthoptera and Hemiptera are particularly numerous; as likewise is the stinging division of the Hymenoptera; the bees, perhaps, being excepted. A person, on first entering a tropical forest, is astonished at the labours of the ants: well-beaten paths branch off in every direction, on which an army of never-failing foragers may be seen, some going forth, and others returning, burdened with pieces of green leaf, often larger than their own bodies.

A small dark-coloured species sometimes migrates in countless numbers. One day, at Bahia, my attention was drawn by observing many spiders, cockroaches, and other insects, and some lizards, rushing in the greatest agitation across a bare piece of ground. A little way behind, every stalk and leaf was blackened by a small ant. The swarm having crossed the bare space, divided itself, and descended an old wall. By this means many insects were fairly enclosed; and the efforts, which the poor little creatures made to extricate themselves from such a death, were wonderful.

When the ants came to the road they changed their course, and in narrow files reascended the wall. Having placed a small stone, so as to intercept one of the lines, the whole body attacked it, and then immediately retired. Shortly afterwards another body came to the charge, and again having failed to make any impression, this line of march was entirely given up. By going an inch round, the file might have avoided the stone, and this doubtless would have happened, if it had been originally there: but having been attacked, the lion-hearted little warriors scorned the idea of yielding.

Certain wasp-like insects, which construct in the corners of the verandahs clay cells for their larvæ, are very numerous in the neighbourhood of Rio. These cells they stuff full of dead and dying spiders and caterpillars. I was much interested one day by watching a deadly contest between a Pepsis and a large spider of the genus Lycosa. The wasp made a sudden dash at its prey, and then flew away: the spider was evidently wounded, for trying to escape, it rolled down a little slope, but had still strength sufficient to crawl into a thick tuft of grass. The wasp soon returned, and seemed surprised at not immediately finding its victim. It then commenced as regular a hunt, as ever hound did after fox; making short semicircular casts, and all the time rapidly vibrating its wings and antennæ. The spider, though well concealed, was soon discovered; and the wasp, evidently still afraid of its adversary's jaws, after much manœuvring, inflicted two stings on the under side of its thorax. At last, carefully examining with its antennæ the now motionless spider, it proceeded to drag away the body. But I stopped both tyrant and prey.*

The number of spiders in proportion to other insects, is

* Don Felix Azara, vol. i., p. 175, mentioning a hymenopterous insect, probably of the same genus, says, he saw it dragging a dead spider through tall grass, in a straight line to its nest, which was one hundred and sixty-three paces distant. He adds that the wasp, in order to find the road, every now and then made "demi-tours d'environ trois palmes."

here as compared to England very much increased; perhaps more so, than with any other division of the articulate animals. The variety of species among the saltigrade, or jumping spiders, appears almost infinite. The genus, or rather family of Epeira, is here characterized by many singular forms; some species have pointed coriaceous shells, others enlarged and spiny tibiæ. Every path in the forest is barricaded with the strong yellow web of a species, belonging to the same division with the *Epeira clavipes* of Fabricius, which was formerly said by Sloane to make, in the West Indies, webs so strong as to catch birds. A small and pretty kind of spider, with very long anterior legs, and which appears to belong to an undescribed genus, lives as a parasite on almost every one of these webs. I suppose it is too insignificant to be noticed by the great Epeira, and is therefore allowed to prey on the minute insects, which adhering to the lines, would otherwise be wasted. When frightened, this little spider either feigns death by extending its front legs, or suddenly drops from the web. A large Epeira of the same division with *Epeira tuberculata* and *conica* (with fleshy prominences on its abdomen) is extremely common, especially in dry situations. Its web, which is generally placed among the great leaves of the common agave, is sometimes strengthened near the centre by a pair or even four zigzag ribbons, which connect two adjoining rays. When any large insect, as a grasshopper or wasp, is caught, the spider, by quickly giving it a revolving movement, and at the same time emitting a band of threads from its spinners, soon envelops its prey in a case like the cocoon of a silkworm. The spider now examines the powerless victim, and gives the fatal bite on the hinder part of its thorax; then retreating, it patiently waits till the poison has taken effect. The virulence of this poison may be judged of, from the fact that in half a minute I opened the mesh, and found a large wasp quite lifeless. This Epeira always stands with its head downwards near the centre of the web. When disturbed, it acts differently according to circumstances: if

there is a thicket below, it suddenly falls down. I may remark, that I have distinctly seen the thread from the spinners, lengthened by the will of the animal while yet stationary, as preparatory to its fall. If the ground is clear beneath, the Epeira seldom falls, but moves quickly through a central passage, from one to the other side. When still further disturbed, it practices a most curious manœuvre: standing in the middle, it violently jerks the web, which is attached to elastic twigs, till at last the whole acquires such a rapid vibratory movement, that even the outline of the spider's body becomes indistinct.

I will here just mention a gregarious Epeira found in great numbers near St. Fe Bajada, the capital of one of the provinces of La Plata. The spiders were of a large size, and of a black colour, with ruby marks on their backs. They were nearly all of one dimension, and therefore could not have been a few old individuals with their families. The webs were placed vertically, as is invariably the case with the genus Epeira: they were separated from each other by a space of about two feet, but were all attached to certain common lines, which were of great length, and extended to all parts of the community. In this manner the tops of some large bushes were encompassed by the united nets. Azara* has described a gregarious spider in Paraguay, which Walckenaer thinks must be a Theridion, but probably it is an Epeira, and perhaps even the same species as mine. I cannot, however, recollect seeing a central nest, as large as a hat, in which, during autumn when the spiders die, Azara says the eggs are deposited. These gregarious habits in so typical a genus as Epeira, present a singular case among insects, which are so bloodthirsty and solitary, that even the sexes attack each other.

In a lofty valley of the Cordillera, near Mendoza, I found another spider with a singularly-formed web. Strong lines radiated in a vertical plane from a common centre, where

* Azara's Voyage, vol. i., p. 213.

the insect had its station; but only two of the rays were connected by a symmetrical mesh-work; so that the net, instead of being, as is generally the case, circular, consisted of a wedge-shaped segment. All the webs were similarly constructed.

CHAPTER III.

Monte Video—Maldonado—Excursion to R. Polanco—Lazo and Bolas—Partridges—Geology—Absence of trees—Cervus campestris—River hog—Tucutuco—Molothrus, cuckoo-like habits—Tyrant-flycatcher—Mocking-bird—Carrion hawks—Tubes formed by lightning—House struck.

MALDONADO.

JULY 5TH, 1832.—In the morning we got under way, and stood out of the splendid harbour of Rio de Janeiro. In our passage to the Plata, we saw nothing particular, excepting on one day a great shoal of porpoises, many hundreds in number. The whole sea was in places furrowed by them; and a most extraordinary spectacle was presented, as hundreds, proceeding together by jumps, in which their whole bodies were exposed, thus cut the water. When the ship was running nine knots, these animals could cross and recross the bows with the greatest ease, and then dash away right ahead. As soon as we entered the estuary of the Plata, the weather was very unsettled. One dark night we were surrounded by numerous seals and penguins, which made such strange noises, that the officer on watch reported he could hear the cattle bellowing on shore. On a second night we witnessed a splendid scene of natural fireworks; the mast-head and yard-arm ends shone with St. Elmo's light; and the form of the vane could almost be traced, as if it had been rubbed with phosphorus. The sea was so highly luminous, that the tracks of the penguins were marked by a fiery wake, and lastly, the darkness of the sky was momentarily illuminated by the most vivid lightning.

When within the mouth of the river, I was interested by observing how slowly the waters of the sea and river mixed. The latter, muddy and discoloured, from its less specific gravity, floated on the surface of the salt water. This was

curiously exhibited in the wake of the vessel, where a line of blue was seen mingling in little eddies, with the adjoining fluid.

JULY 26TH.—We anchored at Monte Video. The Beagle was employed in surveying the extreme southern and eastern coasts of America, south of the Plata, during the two succeeding years. To prevent useless repetitions, I will extract those parts of my journal which refer to the same districts, without always attending to the order in which we visited them.

MALDONADO is situated on the northern bank of the Plata, and not very far from the mouth of the estuary. It is a most quiet, forlorn, little town; built, as is universally the case in these countries, with the streets running at right angles to each other, and having in the middle a large plaza or square, which, from its size, renders the scantiness of the population more evident and more unsociable. It possesses scarcely any trade; the exports being confined to a few hides and living cattle. The inhabitants are chiefly landowners, together with a few shopkeepers and the necessary tradesmen, such as blacksmiths and carpenters, who do nearly all the business for a circuit of fifty miles round. The town is separated from the river by a band of sand-hillocks, about a mile broad: it is surrounded on all other sides, by an open slightly-undulating country, covered by one uniform layer of fine green turf, on which countless herds of cattle, sheep, and horses graze. There is very little land cultivated even close to the town. A few hedges, made of cacti and agave, mark out where some wheat or Indian corn has been planted. The features of the country are very similar along the whole northern bank of the Plata. The only difference is, that here the granitic hills are rather more boldly pronounced. The scenery is very uninteresting; there is scarcely a house, an enclosed piece of ground, or even a tree, to give it an air of cheerfulness. Yet, after being imprisoned for some time in a ship, there is a charm in the unconfined feeling of walking over boundless plains of turf. Moreover, if your view is

limited to a small space, many objects possess beauty. Some of the smaller birds are brilliantly coloured; and the bright green sward, browsed short by the cattle, is ornamented by dwarf flowers, among which a plant, looking like the daisy, claimed the place of an old friend. What would a florist say to whole tracts so thickly covered by the *Verbena melindres*, as, even at a distance, to appear of the most gaudy scarlet?

I staid ten weeks at Maldonado, in which time a nearly perfect collection of the animals, birds, and reptiles, was procured. Before making any observations respecting them, I will give an account of a little excursion I made as far as the river Polanco, which is about seventy miles distant, in a northerly direction. I may mention, as a proof how cheap every thing is in this country, that I paid only two dollars a day, or eight shillings, for two men, together with a troop of about a dozen riding-horses. My companions were well armed with pistols and sabres; a precaution which I thought rather unnecessary; but the first piece of news we heard was, that, the day before, a traveller from Monte Video had been found dead on the road, with his throat cut. This happened close to a cross, the record of a former murder.

On the first night we slept at a retired little country-house; and there I soon found out, that I possessed two or three articles, especially a pocket compass, which created unbounded astonishment. In every house I was asked to show the compass, and by its aid, together with a map, to point out the direction of various places. It excited the liveliest admiration that I, a perfect stranger, should know the road (for direction and road are synonymous in this open country) to places where I had never been. At one house a young woman, who was ill in bed, sent to entreat me to come and show her the compass. If their surprise was great, mine was greater, to find such ignorance among people who possessed their thousands of cattle, and "estancias" of great extent. It can only be accounted for by the circumstance that this retired part of the country is seldom visited by

foreigners. I was asked whether the earth or sun moved; whether it was hotter or colder to the north; where Spain was, and many other such questions. The greater number of the inhabitants had an indistinct idea that England, London, and North America, were different names for the same place; but the better informed well knew that London and North America were separate countries close together, and that England was a large town in London! I carried with me some promethean matches, which I ignited by biting; it was thought so wonderful that a man should strike fire with his teeth, that it was usual to collect the whole family to see it: I was once offered a dollar for a single one. Washing my face in the morning, caused much speculation at the village of Las Minas; a superior tradesman closely cross-questioned me about so singular a practice; and likewise why on board we wore our beards; for he had heard from my guide that we did so. He eyed me with much suspicion; perhaps he had heard of ablutions in the Mahomedan religion, and knowing me to be a heretick, probably he came to the conclusion that all hereticks were Turks. It is the general custom in this country to ask for a night's lodging at the first convenient house. The astonishment at the compass, and my other feats in jugglery, was to a certain degree advantageous, as with that, and the long stories my guides told of my breaking stones, knowing venemous from harmless snakes, collecting insects, &c., I repaid them for their hospitality. I am writing as if I had been among the inhabitants of central Africa: Banda Oriental would not be flattered by the comparison; but such were my feelings at the time.

The next day we rode to the village of Las Minas. The country was rather more hilly, but otherwise continued the same; an inhabitant of the Pampas no doubt would have considered it as truly Alpine. The country is so thinly inhabited, that during the whole day we scarcely met a single person. Las Minas is much smaller even than Maldonado. It is seated on a little plain, and is surrounded by low rocky

mountains. It is of the usual symmetrical form; and with its whitewashed church standing in the centre, had rather a pretty appearance. The outskirting houses rose out of the plain like isolated beings, without the accompaniment of gardens or courtyards. This is generally the case in the country, and all the houses have, in consequence, an uncomfortable aspect. At night we stopped at a pulperia, or drinking-shop. During the evening a great number of Gauchos came in to drink spirits and smoke cigars: their appearance is very striking; they are generally tall and handsome, but with a proud and dissolute expression of countenance. They frequently wear their moustaches, and long black hair curling down their backs. With their brightly-coloured garments, great spurs clanking about their heels, and knives stuck as daggers (and often so used) at their waists, they look a very different race of men from what might be expected from their name of Gauchos, or simple countrymen. Their politeness is excessive: they never drink their spirits without expecting you to taste it; but whilst making their exceedingly graceful bow, they seem quite as ready, if occasion offered, to cuty our throat.

On the third day we pursued rather an irregular course, as I was employed in examining some beds of marble. On the fine plains of turf we saw many ostriches (*Struthio Rhea*). Some of the flocks contained as many as twenty or thirty birds. These, when standing on any little eminence, and seen against the clear sky, presented a very noble appearance. I never met with such tame ostriches in any other part of the country: it was easy to gallop up within a short distance of them; but then, expanding their wings, they made all sail right before the wind, and soon left the horse astern.

At night we came to the house of Don Juan Fuentes, a rich landed proprietor, but not personally known to either of my companions. On approaching the house of a stranger, it is usual to follow several little pieces of etiquette: riding

up slowly to the door, the salutation of Ave Maria* is given, and until somebody comes out, and asks you to alight, it is not customary even to get off your horse. Having entered the house, some general conversation is kept up for a few minutes, till permission is asked to pass the night there. This is granted as a matter of course. The stranger then takes his meals with the family, and a room is assigned him, where with the horsecloths belonging to his recado (or saddle of the Pampas) he makes his bed. It is curious how similar circumstances produce such similar results in manners. At the Cape of Good Hope the same hospitality, and very nearly the same points of etiquette, are universally observed. The difference, however, between the character of the Spaniard and that of the Dutch boor is shown, by the former never asking his guest a single question beyond the strictest rule of politeness, whilst the honest Dutchman demands where he has been, where he is going, what is his business, and even how many brothers, sisters, or children he may happen to have.

Shortly after our arrival at Don Juan's, one of the large herds of cattle was driven in towards the house, and three beasts were picked out to be slaughtered for the supply of the establishment. These half-wild cattle are very active; and knowing full well the fatal lazo, they led the horses a long and laborious chase. After witnessing the rude wealth displayed in the number of cattle, men, and horses, Don Juan's miserable house was quite curious. The floor consisted of hardened mud, and the windows were without glass; the furniture of the sitting-room boasted only of a few of the roughest chairs and stools, with a couple of tables. The supper, although several strangers were present, consisted of two huge piles, one of roast beef, the other of boiled, with some pieces of pumpkin: besides this latter there was no other vegetable, and not even a morsel of bread. For drink-

* The formal answer of the owner of the place is, "sin pecado concebida"—(conceived without sin).

ing, a large earthenware jug of water served the whole party. Yet this man was the owner of several square miles of land, of which nearly every acre would produce corn, and, with a little trouble, all the common vegetables. The evening was spent in smoking, with a little impromptu singing, accompanied by the guitar. The signoritas all sat together in one corner of the room, and did not sup with the men.

So many works have been written about these countries, that it is almost superfluous to describe either the lazo or the bolas. The former consists of a very strong, but thin, well-plaited rope, made of raw hide. One end is attached to the broad surcingle, which fastens together the complicated gear of the recado, or saddle used in the Pampas; the other is terminated by a small ring of iron or brass, by which a noose can be formed. The Gaucho, when he is going to use the lazo, keeps a small coil in his bridle hand, and in the other holds the running noose, which is made very large, generally having a diameter of about eight feet. This he whirls round his head, and by the dexterous movement of his wrist keeps the noose open; then, throwing it, he causes it to fall on any particular spot he chooses. The lazo, when not used, is tied up in a small coil to the after part of the recado. The bolas, or balls, are of two kinds: the simplest, which is chiefly used for catching ostriches, consists of two round stones, covered with leather, and united by a thin plaited thong, about eight feet long. The other kind differs only, in having three balls united by the thongs to a common centre. The Gaucho holds the smallest of the three in his hand, and whirls the other two round and round his head; then, taking aim, sends them like chain shot revolving through the air. The balls no sooner strike any object, than, winding round it, they cross each other, and become firmly hitched. The size and weight of the balls varies, according to the purpose for which they are made: when of stone, although not so large as a big apple, yet they are sent with such force as sometimes to break the leg even of a horse. I have seen the balls made

of wood, and as large as a turnip, for the sake of catching these animals without injuring them. The balls are sometimes made of iron, and these can be hurled to the greatest distance. The main difficulty in using either lazo or bolas, is to ride so well, as to be able at full speed, and while suddenly turning about, to whirl them so steadily round the head, as to take aim: on foot any person would soon learn the art. One day, as I was amusing myself by galloping and whirling the balls round my head, by accident the free one struck a bush; and its revolving motion being thus destroyed, it immediately fell to the ground, and like magic caught one hind leg of my horse; the other ball was then jerked out of my hand, and the horse fairly secured. Luckily he was an old practised animal, and knew what it meant; otherwise he would probably have kicked till he had thrown himself down. The Gauchos roared with laughter; they cried they had seen every sort of animal caught, but had never before seen a man caught by himself.

During the two succeeding days, I reached the furthest point which I was anxious to examine. The country wore the same aspect, till at last the fine green turf became more wearisome than a dusty turnpike road. We every where saw great numbers of partridges (*Tinamus rufescens*). These birds do not go in coveys, nor do they conceal themselves like the English kind. It appears a very silly bird. A man on horseback by riding round and round in a circle, or rather in a spire, so as to approach closer each time, may knock on the head as many as he pleases. The more common method is to catch them with a running noose, or little lazo, made of the stem of an ostrich's feather, fastened to the end of a long stick. A boy on a quiet old horse will frequently thus catch thirty or forty in a day. The flesh of this bird, when cooked, is delicately white.

On our return to Maldonado, we followed rather a different line of road. Near Pan de Azucar, a landmark well known to all those who have sailed up the Plata, I stayed a day at the house of a most hospitable old Spaniard. Early

in the morning we ascended the Sierra de las Animas. By the aid of the rising sun the scenery was almost picturesque. To the westward the view extended over an immense level plain as far as the mount, at Monte Video, and to the eastward, over the mammillated country of Maldonado. On the summit of the mountain there were several small heaps of stones, which evidently had lain there for many years. My companion assured me that they were the work of the Indians in the old time. The heaps were similar, but on a much smaller scale, to those so commonly found on the mountains of Wales. The desire to signalize any event, on the highest point of the neighbouring land, seems an universal passion with mankind. At the present day, not a single Indian, either civilized or wild, exists in this part of the province; nor am I aware that the former inhabitants have left behind them any more permanent records, than these insignificant piles on the summit of the Sierra de las Animas.

The geological structure of the country is very simple. On the crest of every hill, granitic or ancient schistose rocks protrude; the intervening spaces being concealed by a great thickness of a red argillaceous earth. This at first sight would be mistaken for ordinary detritus; but on closer examination it is found to contain small concretionary balls of a friable limestone or marl, and to possess other peculiar characters. It extends over the whole province, and in some places is very remarkable, from containing the remains of several great extinct animals. This red earthy substance is part of the formation which composes those immense plains of Buenos Ayres, denominated the Pampas. For its origin, we must look to a period when the estuary of the Plata, occupying far wider limits, covered all the surrounding low countries with its brackish waters. Signs of the gradual elevation of the land can in many places be discovered on the shores of the river; and it is probable that the red earthy mass is, geologically speaking, of no very ancient date.

The general, and almost entire absence of trees in Banda Oriental is remarkable. Some of the rocky hills are partly covered by thickets, and on the banks of the larger streams, especially to the northward of the Las Minas, willow-trees are not uncommon. Near the Arroyo Tapes I heard of a wood of palms; and one of these trees, of considerable size, I saw near the Pan de Azucar, in lat. 35°. These, and the trees planted by the Spaniards, offer the only exceptions to the general scarcity of wood. Among the introduced kinds may be enumerated poplars, olives, peach, and other fruit-trees: the peaches succeed so well, that they afford the main supply of firewood to the city of Buenos Ayres. Extremely level countries, such as the Pampas, seldom appear favourable to the growth of trees. This may possibly be attributed either to the force of the winds, or the kind of drainage. In the nature of the land, however, around Maldonado, no such reason is apparent; the rocky mountains afford protected situations, enjoying various kinds of soil; streamlets of water are common at the bottoms of nearly every valley; and the clayey nature of the earth seems adapted to retain moisture. It has been inferred with much probability, that the presence of woodland is determined by the annual amount of moisture; yet in this province abundant and heavy rain falls during the winter; and the summer, though dry, is not so in any excessive degree.* We see nearly the whole of Australia covered by lofty trees, yet that country possesses a far more arid climate. Hence we must look to some other cause. The trees of Brazil cannot travel so far southward, on account of the colder climate; nor does there exist any other wooded country whence a migration could take place: we are therefore driven to the conclusion that herbaceous plants, instead of trees, were created to occupy that wide area, which within a period not very remote, has been raised above the waters of the sea.

* Azara says, "Je crois que la quantité annuelle des pluies est, dans toutes ces contrées, plus considérable qu'en Espagne."—Vol. i., p. 36.

Considering South America alone, we should be tempted to believe that trees could not possibly flourish, excepting in a very humid climate. The limit of the forest land certainly follows, in a most remarkable manner, that of the damp winds.* In the southern part of the continent, where the western gales, charged with moisture from the Pacific, prevail, every island on the broken west coast, from lat. 38° to the extreme point of Tierra del Fuego is densely covered by impenetrable forest. On the eastern side of the Cordillera, over the same extent of latitude, where a blue sky and a fine climate prove that the atmosphere has been drained of its moisture, the arid plains of Patagonia support a scanty vegetation. Within the limits of the constant south-east trade wind, the bulk of the eastern parts of the continent is ornamented by magnificent forests: the west coast, however, from lat. 4° south to lat. 32°, may be described as a desert. In this case, as before, all the vapour has been condensed by the snow-clad pinnacles of the Andes. In these two areas, determined by the prevalent winds, the forest and desert lands occupy reversed positions with respect to the great mountain axis. Between their limits a broad intermediate band, which is neither desert nor woodland, stretches across the entire continent. Central Chile and the Provinces of La Plata are included in this division. On the west coast, about four degrees south of the equator, where the trade wind loses its regularity, and heavy torrents of rain periodically fall, the desert coast of Peru assumes near Cape Blanco the character of luxuriance so celebrated at Guayaquil and on the shores of Panama.

After these facts, it will perhaps appear a sufficient answer to the question, to state that according to the South American type of vegetation, the climate of Banda Oriental is too dry for the growth of trees. But this reasoning, I apprehend, must not be extended to a general statement including other countries. The Falklands offer a more per-

* Maclaren, art. *America*, Encyc. Britan.

plexing case even than Maldonado. Situated under the same latitude with Tierra del Fuego, and only between two and three hundred miles distant from it, possessed of an entirely similar climate, with a geological formation almost identical, with favourable situations, and the same kind of peaty soil, yet these islands can scarcely boast of a plant deserving the title even of a bush; whilst in Tierra del Fuego, it is impossible to find an acre of land not covered by the densest forest. In this case, both the direction of the heavy gales of wind and of the currents of the sea are favourable to the transport of seeds. Canoes and other works of art, and trunks of trees, drifted from Tierra del Fuego, are frequently thrown on the shores of the Western Island. Hence perhaps it is that there are many plants common to the two countries: but with respect to trees, even some attempts which have been made to transplant them, have failed.

During our stay at Maldonado I paid particular attention to the mammalia and birds. Of the latter I procured, within the distance of a morning's walk, no less than eighty species, of which many were exceedingly beautiful—I think even more so than those of Brazil. The other orders were not neglected. Reptiles were numerous, and nine different kinds of snakes were taken. Of the indigenous mammalia, the only one now left of any size, which is common, is the *Cervus Campestris*. This deer is exceedingly abundant throughout the countries bordering the Plata. It is found in Northern Patagonia as far south as the Rio Negro (lat. 41°); but further southward none were seen by the officers employed in surveying the coast. It appears to prefer a hilly country; I saw very many small herds, containing from five to seven animals each, near the Sierra Ventana, and among the hills north of Maldonado. If a person crawling close along the ground, slowly advances towards a herd, the deer frequently, out of curiosity, approach to reconnoitre him. I have by this means killed, from one spot, three out of

the same herd. Although so tame and inquisitive, yet when approached on horseback, they are exceedingly wary. In this country nobody goes on foot, and the deer knows man as its enemy, only when he is mounted and armed with the bolas. At Bahia Blanca, a recent establishment in Northern Patagonia, I was surprised to find how little the deer cared for the noise of a gun: one day I fired ten times, from within eighty yards, at one animal; and it was much more startled at the ball cutting up the ground than at the report of the rifle. My powder being exhausted, I was obliged (to my shame as a sportsman be it spoken), to get up and halloo till the deer ran away.

The most curious fact with respect to this animal, is the overpoweringly strong and offensive odour which proceeds from the buck. It is quite indescribable: several times whilst skinning the specimen which is now mounted at the Zoological Museum, I was almost overcome by nausea. I tied up the skin in a silk pocket-handkerchief, and so carried it home: this handkerchief, after being well washed, I continually used, and it was, of course, as repeatedly washed; yet every time, for a space of one year and seven months, when first unfolded, I distinctly perceived the odour. This appears an astonishing instance of the permanence of some matter, which in its nature, nevertheless, must be most subtile and volatile. Frequently, when passing at the distance of half a mile to leeward of a herd, I have perceived the whole air tainted with the effluvium. I believe the smell from the buck is most powerful at the period when its horns are perfect, or free from the hairy skin. When in this state the meat is, of course, quite uneatable; but the Gauchos assert, that if buried for some time in fresh earth, the taint is removed. I have somewhere read that the islanders in the north of Scotland treat the rank carcasses of the fish-eating birds in the same manner.

The order Rodentia is here very numerous in species: of

mice alone I obtained no less than eight kinds.* The largest gnawing animal in the world, the *Hydrochærus Capybara* (the water-hog), is here also common. One which I shot at Monte Video weighed ninety-eight pounds: its length, from the end of the snout to the stump-like tail, was three feet two inches; and its girth, three feet eight. These great Rodents are generally called "carpinchos:" they occasionally frequent the islands in the mouth of the Plata, where the water is quite salt, but are far more abundant on the borders of fresh-water lakes and rivers. Near Maldonado three or four generally live together. In the daytime they either lie among the aquatic plants, or openly feed on the turf plain.† When viewed at a distance, from their manner of walking and colour, they resemble pigs: but when seated on their haunches, and attentively watching any object with one eye, they reassume the appearance of their congeners, the cavies. Both the front and side view of their head has quite a ludicrous aspect, from the great depth of their jaw. These animals, at Maldonado, were very tame; by cautiously walking, I approached within three yards of four old ones. This tameness may probably be accounted for, by the Jaguar having been banished for some years, and by the Gaucho not thinking it worth his while to hunt them. As I approached nearer and nearer they frequently made their peculiar noise, which is a low abrupt grunt; not having much actual sound,

* These have been named and described by Mr. Waterhouse at the meetings of the Zoological Society. I must be allowed to take this opportunity of returning my cordial thanks to Mr. Waterhouse, and to the other gentlemen attached to that Society, for their kind and most liberal assistance on all occasions.

† In the stomach and duodenum of a carpincho which I opened, I found a very large quantity of a thin yellowish fluid, in which scarcely a fibre could be distinguished. Mr. Owen informs me that a part of the œsophagus is so constructed, that nothing much larger than a crowquill can be passed down. Certainly the broad teeth and strong jaws of this animal are well fitted to grind into pulp the aquatic plants on which it feeds.

but rather arising from the sudden expulsion of air: the only noise I know at all like it, is the first hoarse bark of a large dog. Having watched the four from almost within arm's length (and they me) for several minutes, they rushed into the water at full gallop, with the greatest impetuosity, and emitted, at the same time, their bark. After diving a short distance they came again to the surface, but only just showed the upper part of their heads. When the female is swimming in the water and has young ones, they are said to sit on her back. These animals are easily killed in numbers; but their skins are of trifling value, and the meat is very indifferent. I have never heard of the carpincho being found south of the Plata; but as I see in a map that there is a Laguna del Carpincho high up the Rio Salado, I suppose such must have occurred. On the islands in the Rio Parana they are exceedingly abundant, and afford the ordinary prey to the Jaguar.

The Tucutuco (*Ctenomys Braziliensis*) is a curious small animal, which may be briefly described as a Rodent, with the habits of a mole. It is extremely abundant in some parts of the country,* but is difficult to be procured, and still more difficult to be seen, when at liberty. It lives almost entirely under ground, and prefers a sandy soil with a gentle inclination. The burrows are said not to be deep, but of great length. They are seldom open; the earth being thrown up at the mouth into hillocks, not quite so large as those made by the mole. Considerable tracts of country are so completely undermined by these animals, that horses, in passing over, sink above their fetlocks. The tucutucos appear, to a certain degree, to be gregarious. The man who procured the specimens for me had caught six together, and he said this was a common occurrence. They are nocturnal

* The wide plains north of the Rio Colorado are undermined by these animals; and near the Strait of Magellan, where Patagonia blends with Tierra del Fuego, the whole sandy country forms a great warren for the tucutuco.

in their habits; and their principal food is afforded by the roots of plants, which is the object of their extensive and superficial burrows. Azara says they are so difficult to be obtained, that he never saw more than one. He states that they lay up magazines of food within their burrows. This animal is universally known by a very peculiar noise, which it makes when beneath the ground. A person, the first time he hears it, is much surprised; for it is not easy to tell whence it comes, nor is it possible to guess what kind of creature utters it. The noise consists in a short, but not rough, nasal grunt, which is repeated about four times in quick succession; the first grunt is not so loud, but a little longer, and more distinct than the three following: the musical time of the whole is constant, as often as it is uttered.* The name Tucutuco is given in imitation of the sound. In all times of the day, where this animal is abundant, the noise may be heard, and sometimes directly beneath one's feet. When kept in a room, the tucutucos move both slowly and clumsily, which appears owing to the outward action of their hind legs; and they are likewise quite incapable of jumping even the smallest vertical height. Mr. Reid, who dissected a specimen which I brought home in spirits, informs me that the socket of the thigh-bone is not attached by a ligamentum teres; and this explains, in a satisfactory manner, the awkward movements of their hinder extremities. When eating, they rest on their hind legs and hold the piece in their fore paws; they appeared also to wish to drag it into some corner. They are very stupid in making any attempt to escape; when angry or

* At the R. Negro, in Northern Patagonia, there is an animal of the same habits, and probably a closely allied species, but which I never saw. Its noise is different from the Maldonado kind; it is repeated only twice instead of three or four times, and is more distinct and sonorous: when heard from a distance, it so closely resembles the sound made in cutting down a small tree with an axe, that I have sometimes remained in doubt concerning it.

frightened, they uttered the tucu-tuco. Of those I kept alive, several, even the first day, became quite tame, not attempting to bite or to run away; others were a little wilder.

The man who caught them asserted that very many are invariably found blind. A specimen which I preserved in spirits was in this state; Mr. Reid considers it to be the effect of inflammation in the nictitating membrane. When the animal was alive I placed my finger within half an inch of its head, and not the slightest notice was taken: it made its way, however, about the room nearly as well as the others. Considering the subterranean habits of the tucutuco, the blindness, though so frequent, cannot be a very serious evil; yet it appears strange that any animal should possess an organ constantly subject to injury. The mole, whose habits in nearly every respect, excepting in the kind of food, are so similar, has an extremely small and protected eye, which, although possessing a limited vision, at once seems adapted to its manner of life.

Birds of many kinds are extremely abundant on the undulating grassy plains around Maldonado. Several species, of the genus Cassicus, allied to our starlings in habits and structure, and of Tyrant-flycatchers, and a mocking-bird, from their numbers, give a character to the ornithology. Some of the Cassici are very beautiful, black and yellow being the prevailing colours; but *Oriolus ruber*, Gme., offers an exception, in having its head, shoulders, and thighs of the most splendid scarlet. This bird differs from its congeners in being solitary. It frequents marshes; and, seated on the summit of a low bush, with its mouth wide open, utters a plaintive agreeable cry, which can be heard at a long distance.

Another species,* of a purplish-black colour, with a metallic lustre, feeds on the plain in large flocks, mingled

* Le Troupiale commun of Azara (vol. iii., p. 169)—a second species of Molothrus.

with other birds. Several may often be seen standing on the back of a cow or horse. While perched on a hedge, and pluming themselves in the sun, they sometimes attempt to sing, or rather to hiss: the noise is very peculiar; it resembles that of bubbles of air passing rapidly from a small orifice under water, so as to produce an acute sound. Azara states that this bird, like the cuckoo, deposits its eggs in other birds' nests. I was several times told by the country people, that there was some bird with this habit; and my assistant in collecting, who is a very accurate person, found a nest of the sparrow* of the country, with one egg in it larger than the others, and of a different colour and shape. Mr. Swainson† has remarked that with the exception of the *Molothrus pecoris*, the cuckoos are the only birds which can be called truly parasitical; namely, such as "fasten themselves, as it were, on another living animal, whose animal heat brings their young into life, whose food they alone live upon, and whose death would cause theirs during the period of infancy." The *Molothrus pecoris* is a North-American bird, and is closely allied in general habits, even in such peculiarities as standing on the backs of cattle (as its name implies), and in appearance, with the species from the plains of La Plata; it only differs in being rather smaller and of a different colour, yet the two birds would be considered by every naturalist as distinct species. It is very interesting to see so close an agreement in structure, and in habits, between allied species coming from opposite parts of a great continent. It is also very remarkable, that the cuckoos and the molothri, although opposed to each other in almost every habit, should agree in the one strange one of their parasitical propagation. The molothrus, like our starling, is

* A Zonotrichia;—the *chingolo* of Azara. The egg is rather less than that of the missel-thrush; it is of a nearly globular form, but with one end rather smaller than the other. The ground colour is a pale pinkish-white, with irregular spots and blotches of a pinkish brown, and others less distinct of a grayish hue. The egg is now in the museum of the Zoological Society.

† Magazine of Zoology and Botany, vol. i., p. 217.

eminently sociable, and lives on the open plains without art or disguise:* the cuckoo, as every one knows, is a singularly shy bird; it frequents the most retired thickets, and feeds on fruit and caterpillars. In structure these birds are likewise widely removed from each other.

I will only mention two other birds, which are very common, and render themselves prominent from their habits. The *Saurophagus sulphureus* is typical of the great American tribe of Tyrant-flycatchers. In its structure it closely approaches the true shrikes, but in its habits may be compared to many birds. I have frequently observed it, hunting a field, hovering over one spot like a hawk, and then proceeding on to another. When thus seen suspended in the air, it might very readily at a short distance be mistaken for one of the Rapacious order; its stoop, however, is very inferior in force and rapidity. At other times the Saurophagus haunts the neighbourhood of water, and there, like a kingfisher, remaining stationary, it catches any small fish which may come near the margin. These birds are not unfrequently kept either in cages, or in courtyards with their wings cut. They soon become tame, and are very amusing from their cunning odd manners, which were described to me, as being similar to those of the common magpie. Their flight is undulatory, for the weight of the head and bill appear too great for the body. In the evening the Saurophagus takes its stand on a bush, often by the road-side, and continually repeats, without change, a shrill and rather agreeable cry, which somewhat resembles articulate words. The Spaniards say it is like the words, "Bien te veo" (I see you well), and accordingly have given it this name.

A mocking-bird, *Orpheus modulator*, called by the inhabitants Calandria, is remarkable, from possessing a song far superior to that of any other bird in the country: indeed, it is nearly the only bird in South America which I have observed to take its stand for the purpose of singing. The

* See Azara, vol. iii., p. 170.

song may be compared to that of the Sedge warbler, but is more powerful; some harsh notes and some very high ones, being mingled with a pleasant warbling. It is heard only during the spring. At other times its cry is harsh and far from harmonious. It frequents thickets and hedges, is very active, and whilst quickly hopping about, often expands its tail. Near Maldonado these birds were tame and bold; they constantly attended in numbers the country houses, to pick the meat which was hung up on the posts or walls: if any other small bird joined the feast, the Calandria directly chased it away. On the wide uninhabited plains of Patagonia another closely allied species, *O. Patagonica* of D'Orbigny, which frequents the valleys clothed with spiny bushes, is a wilder bird, and has a slightly different tone of voice. It appears to me a curious circumstance, as showing the fine shades of difference in habits, that, judging from this latter respect alone, when I first saw this second species, I thought it was different from the Maldonado kind. Having afterwards procured a specimen, and comparing the two without particular care, they appeared so very similar, that I changed my opinion; but now Mr. Gould* says that they are certainly distinct; a conclusion in conformity with the trifling difference of habit, of which, however, he was not aware.

I will conclude these few ornithological observations with an account of the various carrion-feeding hawks which frequent the extratropical parts of South America. The number, tameness, and disgusting habits of these birds, make them pre-eminently striking to any one accustomed only to the birds of Northern Europe. In this list may be included four species of the Caracara or Polyborus, the Turkey buzzard, the Gallinazo, and the Condor. The Caracaras are, from their structure, placed among the eagles: we shall soon see how ill they become so high a rank. In their habits they well supply the place of our carrion-crows, magpies, and ravens; a tribe of birds which is totally wanting in South

* Mr. Gould was not at the time aware that M. D'Orbigny had described them as different.

America. To begin with the *Polyborus Braziliensis:* this is a common bird, and has a wide geographical range; it is most numerous on the grassy savannahs of La Plata (where it goes by the name of Carrancha), and is far from unfrequent throughout the sterile plains of Patagonia. In the desert between the rivers Negro and Colorado, numbers constantly attended the line of road to devour the carcasses of the exhausted animals which chanced to perish from fatigue and thirst. Although thus common in these dry and open countries, and likewise on the arid shores of the Pacific, it is nevertheless found inhabiting the damp impervious forests of West Patagonia and Tierra del Fuego. The Carranchas, together with the *Polyborus Chimango,* constantly attend in numbers the estancias and slaughtering-houses. If an animal dies on the plain the Gallinazo commences the feast, and then the two Caracaras pick the bones clean. These birds, although thus commonly feeding together, are far from being friends. When the Carrancha is quietly seated on the branch of a tree, or on the ground, the Chimango often continues for a long time flying backwards and forwards, up and down, in a semicircle, trying each time, at the bottom of the curve, to strike its larger relative. The Carrancha takes little notice, except by bobbing its head. Although the Carranchas frequently assemble in numbers, they are not gregarious; for in desert places they may be seen solitary, or more commonly by pairs. Besides the carrion of large animals, these birds frequent the borders of streams and sea beaches, to pick up whatever the waters may cast on shore. In Tierra del Fuego, and on the west coast of Patagonia, they must exclusively live on such supplies.

The Carranchas are said to be very crafty, and to steal great numbers of eggs. They attempt also, together with the Chimango, to pick off the scabs from the sore backs of the horses and mules. The poor animal, on the one hand, with its ears down and its back arched; and, on the other, the hovering bird, eyeing, at the distance of a yard, the disgusting morsel, form a picture, which has been described by

Captain Head with his own peculiar spirit and accuracy. The Carranchas kill wounded animals; but Mr. Bynoe saw one seize in the air a live partridge, which escaped, and was for some time chased on the ground. I believe this circumstance is very unusual: at all events there is no doubt that the chief part of their sustenance is derived from carrion. A person will discover the *Necrophagous* habits of the Carrancha, by walking out on one of the desolate plains, and there lying down to sleep. When he awakes, he will see, on each surrounding hillock, one of these birds patiently watching him with an evil eye. It is a feature in the landscape of these countries, which will be recognised by every one who has wandered over them. If a party goes out hunting with dogs and horses, it will be accompanied, during the day, by several of these attendants. After feeding, the uncovered craw protrudes; at such times, and indeed generally, the Carrancha is an inactive, tame, and cowardly bird. Its flight is heavy and slow, like that of an English rook. It seldom soars; but I have twice seen one at a great height gliding through the air with much ease. It runs (in contradistinction to hopping), but not quite so quickly as some of its congeners. At times the Carrancha is noisy, but is not generally so: its cry is loud, very harsh and peculiar, and may be likened to the sound of the Spanish guttural *g*, followed by a rough double *r r*. Perhaps the Gauchos, from this cause, have called it Carrancha. Molina, who says it is called Tharu in Chile, states, that when uttering this cry, it elevates its head higher and higher, till at last, with its beak wide open, the crown almost touches the lower part of the back. This fact, which has been doubted, is quite true; I have seen them several times with their heads backwards in a completely inverted position. The Carrancha builds a large coarse nest, either in a low cliff, or in a bush or lofty tree. To these observations I may add, on the high authority of Azara, that the Carrancha feeds on worms, shells, slugs, grasshoppers, and frogs; that it destroys young lambs by tearing the umbilical cord; and that it pursues the Gallinazo,

till that bird is compelled to vomit up the carrion it may have recently gorged. Lastly, Azara states that several Carranchas, five or six together, will unite in chase of large birds, even such as herons. All these facts show that it is a bird of very versatile habits and considerable ingenuity.

The *Polyborus Chimango* is considerably smaller than the last species. It is common on both sides of the continent, but does not appear to extend so far northward as the last species. It is found in Chiloe, and on the coast of Patagonia, and I have seen it in Tierra del Fuego. We have already remarked that it feeds on carrion, in common with the Carrancha. It is generally the last bird which leaves the skeleton; and may often be seen within the ribs of a cow or horse, like a bird in a cage. The Chimango often frequents the sea-coast and the borders of lakes and swamps, where it picks up small fish. It is truly omnivorous, and will eat even bread, when thrown out of a house with other offal: I was also assured that they materially injure the potato crops in Chiloe, by stocking up the roots when first planted. In the same island I myself saw them by scores following the plough, and feeding on the worms and larvæ of insects. I do not believe they ever kill birds or animals. They are more active than the Carranchas, but their flight is heavy; I never saw one soar; they are very tame; are not gregarious; commonly perch on stone walls, and not upon trees; and frequently utter a gentle, shrill scream.

The third species of Polyborus* is remarkable from the confined localities which it frequents: we met with it only in one valley in Patagonia. The last species which we have to mention is the *Polyborus Novæ Zelandiæ*. This bird is exceedingly numerous over the whole of the Falkland Islands, which appear to be its metropolis. I was informed by the sealers, that they are found in the Diego Ramirez rocks and the Ildefonso isles, but never on the mainland of Tierra del Fuego. Nor do they occur on Georgia or the more southern

* A species allied to "Montanus" of D'Orbigny, but distinct.

islands. In many respects these hawks resemble in their habits the Carranchas. They live on the flesh of dead animals and on marine productions; and on the Ramirez rocks their whole sustenance must depend on the sea. They are extraordinarily tame and fearless, and haunt the neighbourhood of houses for offal. If a hunting party kills an animal, a number soon collect and patiently await, standing on the ground on all sides. After eating, their uncovered craws are largely protruded, giving them a disgusting appearance. They readily attack wounded birds: a cormorant in this state having taken to the shore, was immediately seized on by several, and its death hastened by their blows. The Beagle was at the Falklands only during the summer, but the officers of the Adventure, who were there in the winter, mention many extraordinary instances of the boldness and rapacity of these birds. They actually pounced on a dog that was lying fast asleep close by one of the party; and the sportsmen had difficulty in preventing the wounded geese from being seized before their eyes. It is said that several together (in this respect resembling the Carranchas) wait at the mouth of a rabbit-hole, and together seize on the animal when it comes out. They were constantly flying on board the vessel when in the harbour; and it was necessary to keep a good look out to prevent the leather being torn from the rigging, and the meat or game from the stern. These birds are very mischievous and inquisitive; they will pick up almost any thing from the ground; a large black glazed hat was carried nearly a mile, as was a pair of the heavy balls, used in catching cattle. Mr. Usborne experienced during the survey a more severe loss, in their stealing a small Kater's compass in a red morocco leather case, which was never recovered. These birds are, moreover, quarrelsome and very passionate; tearing up the grass with their bills from rage. They are not truly gregarious; do not soar; their flight is heavy and clumsy; on the ground they run with extreme quickness, very much like pheasants. They are noisy, uttering several harsh cries; one of which is like that of the English rook; hence the sealers

always so call them. It is a curious circumstance that, when crying out, they throw their heads upwards and backwards, after the same manner as the Carrancha. They build on the rocky cliffs of the sea-coast, but only in the small islets, and not in the two main islands. This is a singular precaution in so tame and fearless a bird. The sealers say that the flesh of these birds when cooked, is quite white, and very good eating.

We have now only to mention the turkey-buzzard (*Vultur aura*), and the Gallinazo. The former is found wherever the country is moderately damp, from Cape Horn to North America. Differently from the *Polyborus Braziliensis* and *Chimango*, it has found its way to the Falkland Islands. The turkey-buzzard is a solitary bird, or at most goes in pairs. It may at once be recognised from a long distance, by its lofty, soaring, and most elegant flight. It is well known to be a true carrion feeder. On the west coast of Patagonia, among the thickly-wooded islets and broken land, it lives exclusively on what the sea throws up, and on the carcasses of dead seals. Wherever these animals are congregated on the rocks, there the vultures may be seen. The Gallinazo (*Cathartes atratus*) has a different range from the last species, as it never occurs to the southward of lat. 41°. Azara states that there existed a tradition that these birds, at the time of the conquest, were not to be found near Monte Video, but that they subsequently followed the inhabitants from more northern districts. At the present day they are numerous in the valley of the Colorado, which is three hundred miles due south of Monte Video. It seems probable that this additional migration has happened since the time of Azara. The Gallinazo generally prefers a humid climate, or rather the neighbourhood of fresh water; hence it is extremely abundant in Brazil and La Plata, while it is never found on the desert and arid plains of Northern Patagonia, excepting near some stream. These birds frequent the whole Pampas to the foot of the Cordillera, but I never saw or heard of one in Chile: in Peru they are preserved as

scavengers. These vultures certainly may be called gregarious, for they seem to have pleasure in society, and are not solely brought together by the attraction of a common prey. On a fine day a flock may often be observed at a great height, each bird wheeling round and round without closing its wings, in the most graceful evolutions. This is clearly done for sport-sake, or perhaps is connected with their matrimonial alliances.

I have now mentioned all the carrion-feeders, excepting the condor, an account of which will be more appropriately introduced when we visit a country more congenial to its habits than the plains of La Plata.

In a broad band of sand-hillocks which separate the Laguna del Potrero from the shores of the Plata, at the distance of a few miles from Maldonado, I found a group of those vitrified, siliceous tubes, which are generally supposed to have been formed by lightning entering the loose sand. These tubes resemble in every particular those from Drigg, in Cumberland, described in the Geological Transactions.* The sand-hillocks of Maldonado, not being protected by vegetation, are constantly changing their position. From this cause the tubes projected above the surface; and numerous fragments lying near, showed that they had formerly been buried to a greater depth. Four sets entered the sand perpendicularly: by working with my hands I traced one of them two feet deep; and some fragments which evidently had belonged to the same tube, when added to the other part, measured five feet three inches. The diameter of the whole was nearly equal, and therefore we must suppose that originally it extended to a much greater depth. These dimensions are however small, compared to those of the tubes from Drigg, one of which was traced to a depth of not less than thirty feet.

The internal surface is completely vitrified, glossy, and smooth. A small fragment examined under the micro-

* Geolog. Transact., vol. ii., p. 528.

scope, appeared, from the number of minute entangled air or perhaps steam bubbles, like an assay fused before the blowpipe. The sand is entirely, or in greater part, siliceous; but some points are of a black colour, and from their glossy surface possess a metallic lustre. The thickness of the wall of the tube varies from a thirtieth to a twentieth of an inch, and occasionally even equals a tenth. On the outside, the grains of sand are rounded, and have a slightly glazed appearance: I could not distinguish any sign of crystallization. In a similar manner to that described in the Geological Transactions, the tubes are generally compressed, and have deep longitudinal furrows, so as closely to resemble a shrivelled vegetable stalk, or the bark of the elm or cork tree. Their circumference is about two inches, but in some fragments which are cylindrical and without any furrows, it is double, or four inches. The compression from the surrounding loose sand, acting while the tube was still softened from the effects of the intense heat, has evidently caused the creases or furrows. Judging from the uncompressed fragments, the measure or bore of the lightning (if such a term may be used), must have been about one inch and a quarter. At Paris, M. Hachette and M. Beaudant* succeeded in making tubes, in most respects similar to these fulgurites, by passing very strong shocks of galvanism through finely-powdered glass: when salt was added, so as to increase its fusibility, the tubes were larger in every dimension. They failed both with powdered felspar and quartz. One tube, formed with pounded glass, was very nearly an inch long, namely, .982, and had an internal diameter of .019. When we hear that the strongest battery in Paris was used, and that the effect on a substance of such easy fusibility as glass, was to form tubes so diminutive, we must feel greatly astonished at the power of a shock of lightning, which, striking the sand in several places, has formed a cylinder, in one instance of at least thirty feet long, and

* Annales de Chimie et de Physique, tom. xxxvii., p. 319.

having an internal bore, where not compressed, of full an inch and a half; and this in a material so extraordinarily refractory as quartz!

The tubes, as I have already remarked, enter the sand nearly in a vertical direction. One, however, which was less regular than the generality, had a deviation from a right line, which amounted, at the most considerable bend, to thirty-three degrees. From this same tube, two small branches, about a foot apart, were sent off; one pointed downwards, and the other upwards. This latter case is remarkable, as the electric fluid must have turned back at the acute angle of 26°, to the line of its main course. Besides the four tubes which I found vertical, and traced beneath the surface, there were several other groups of fragments, the original site of which without doubt was near. All occurred in a level area, sixty yards by twenty, of shifting sand, situated among some high sand-hillocks; and at the distance of about half a mile, from a chain of hills four or five hundred feet in height. The most remarkable circumstance, as it appears to me, in this case as well as in that of Drigg, and in one described by M. Ribbentrop in Germany, is the number of tubes found within such limited spaces. At Drigg, within an area of fifteen yards, three were observed, and the same number occurred in Germany. In the case which I have described, certainly more than four existed within the space of the sixty by twenty yards. As it does not appear probable that the tubes are produced by successive and distinct shocks, we must believe that the lightning, shortly before entering the ground, divides itself into separate branches.

The neighbourhood of the Rio Plata seems peculiarly subject to electric phenomena. In the year 1793,* one of the most destructive thunderstorms perhaps on record happened at Buenos Ayres: thirty-seven places within the city were struck by lightning, and nineteen people killed. From facts stated in several books of travels, I am inclined to suspect

* Azara's Voyage, vol. i., p. 36.

that thunderstorms are very common near the mouths of great rivers. Is it not possible that the mixture of large bodies of fresh water with the salt may disturb the electrical equilibrium? Even during our occasional visits to this part of South America, we heard of a ship, two churches, and a house, having been struck. Both the church and the house I saw shortly afterwards: the house belonged to Mr. Hood, the consul-general at Monte Video. Some of the effects were curious: the paper, for nearly a foot on each side of the line where the bell-wires had run, was blackened. The metal had been fused, and although the room was at least fifteen feet high, the globules dropping on the chairs and furniture, had drilled in them a chain of minute holes. A part of the wall was shattered as if by gunpowder, and the fragments had been blown off with force sufficient to dent the walls on the opposite side of the room. The frame of a looking-glass was blackened, and the gilding must have been volatilized, for a smelling-bottle, which stood on the chimney-piece, was coated with bright metallic particles, which adhered as firmly as if they had been enamelled.

CHAPTER IV.

Rio Negro—Estancias attacked by Indians—Salt lakes, geological position of—Flamingoes—R. Negro to Colorado—Sacred tree—Patagonian hare—Indian families—General Rosas—Proceed to Bahia Blanca—Sand dunes—Negro lieutenant—Bahia Blanca—Ground incrusted with Glauber salt—Punta Alta—Zorillo.

RIO NEGRO TO BAHIA BLANCA.

July 24th, 1833.—The Beagle sailed from Maldonado, and on August the 3d she arrived off the mouth of the Rio Negro. This is the principal river on the whole line of coast between the Straits of Magellan and the Plata. It enters the sea about three hundred miles south of the estuary of the latter. About fifty years since, under the old Spanish government, a small colony was established here; and it is still the most southern position (lat. 41°) on this eastern coast of America which is inhabited by civilized man.

The country near the mouth of the river is wretched in the extreme: on the south side a long line of perpendicular cliffs commences, which exposes a section of the geological nature of the country. The strata are of sandstone, and one layer was remarkable, from being composed of a firmly-cemented conglomerate of pumice pebbles, which must have travelled more than four hundred miles, from the Andes. The surface is every where covered up by a thick bed of gravel, which extends far and wide over the open plain. Water is extremely scarce, and, where found, is almost invariably brackish. The vegetation is scanty; and although there are bushes of many kinds, all are armed with formidable thorns, which seem to warn the stranger not to enter on these inhospitable regions.

The settlement is situated eighteen miles up the river. The road follows the foot of the sloping cliff, which forms

the northern boundary of the great valley, in which the Rio Negro flows. On the way we passed the ruins of some fine "estancias," which a few years since were destroyed by the Indians. They withstood several attacks. A man present at one gave me a very lively description of what took place. The inhabitants had sufficient notice to drive all the cattle and horses into the "corral"* which surrounded the house, and likewise to mount some small cannon. The Indians were Araucanians from the south of Chile; several hundreds in number, and highly disciplined. They first appeared in two bodies on a neighbouring hill; having there dismounted, and taken off their fur mantles, they advanced naked to the charge. The only weapon of an Indian is a very long bamboo or chuzo, ornamented with ostrich feathers, and pointed by a sharp spear head. My informer seemed to remember with the greatest horror the quivering of these chuzos as they approached near. When close, the cacique Pincheira hailed the besieged to give up their arms, or he would cut all their throats. As this would probably have been the result of their entrance under any circumstances, the answer was given by a volley of musketry. The Indians, with great steadiness, came to the very fence of the corral: but to their surprise they found the posts fastened together by iron nails instead of leather thongs, and, of course, in vain attempted to cut them with their knives. This saved the lives of the Christians: many of the wounded Indians were carried away by their companions; and at last one of the under caciques being wounded, the bugle sounded a retreat. They retired to their horses, and seemed to hold a council of war. This was an awful pause for the Spaniards, as all their ammunition, with the exception of a few cartridges, was expended. In an instant the Indians mounted their horses, and galloped out of sight. Another attack was still more quickly repulsed. A cool Frenchman managed the gun; he

* The corral is an enclosure made of tall and strong stakes. Every estancia, or farming estate, has one attached to it.

stopped till the Indians approached close, and then raked their line with grape-shot: he thus laid thirty-nine of them on the ground; and, of course, such a blow immediately routed the whole party.

The town is indifferently called El Carmen or Patagones. It is built on the face of a cliff which fronts the river, and many of the houses are excavated even in the sandstone. The river is about two or three hundred yards wide, and is deep and rapid. The many islands, with their willow-trees, and the flat headlands, seen one behind the other on the northern boundary of the broad green valley, forms, by the aid of a bright sun, a view almost picturesque. The number of inhabitants does not exceed a few hundreds. These Spanish colonies do not, like our British ones, carry within themselves the elements of growth. Many Indians of pure blood reside here: the tribe of the Cacique Lucanee constantly have their Toldos* on the outskirts of the town. The local government partly supplies them with provisions, by giving them all the old, worn out horses, and they earn a little by making horse-rugs and other articles of riding gear. These Indians are considered civilized; but what their character may have gained by a lesser degree of ferocity, is almost counterbalanced by their entire immorality. Some of the younger men are, however, improving; they are willing to labour, and a short time since a party went on a sealing voyage, and behaved very well. They were now enjoying the fruits of their labour, by being dressed in very gay, clean clothes, and by being very idle. The taste they showed in their dress was admirable; if you could have turned one of these young Indians into a statue of bronze, his drapery would have been perfectly graceful.

One day I rode to a large salt lake, or Salina, which is distant fifteen miles from the town. During the winter it consists of a shallow lake of brine, which in summer is converted into a field of snow-white salt. The layer near the

* The hovels of the Indians are thus called.

margin is from four to five inches thick, but towards the centre its thickness increases. This lake was two and a half miles long, and one broad. Others occur in the neighbourhood many times larger, and with a floor of salt, two and three feet in thickness, even when under water during the winter. One of these brilliantly-white and level expanses, in the midst of the brown and desolate plain, offers an extraordinary spectacle. A large quantity of salt is annually drawn from the salina; and great piles, some hundred tons in weight, were lying ready for exportation. It is singular that the salt, although well crystallized, and appearing quite pure, does not answer so well for preserving meat as sea salt from the Cape de Verd Islands. Although the latter is necessarily much dearer, it is constantly imported and mixed with the salt procured from these salinas. A merchant at Buenos Ayres told me that he considered the Cape de Verd salt worth fifty per cent. more than that from the Rio Negro. The season for working the salinas forms the harvest of Patagones; for on it, the prosperity of the place depends. Nearly the whole population encamps on the banks of the river, and the people are employed in drawing out the salt in bullock-waggons.

The border of the lake is formed of mud: and in this numerous large crystals of gypsum, some of which are three inches long, lie embedded; whilst on the surface, others of sulphate of magnesia lie scattered about. The Gauchos call the former the "Padre del sal," and the latter the "Madre"; they state that these progenitive salts always occur on the borders of the salinas, when the water begins to evaporate. The mud is black, and has a fetid odour. I could not, at first, imagine the cause of this, but I afterwards perceived that the froth, which the wind drifted on shore was coloured green, as if by confervæ: I attempted to carry home some of this green matter, but from an accident failed. Parts of the lake seen from a short distance appeared of a reddish colour, and this, perhaps, was owing to some infusorial animalcula. The mud in many places was thrown up by numbers of

some kind of worm, or annelidous animal. How surprising it is that any creatures should be able to exist in a fluid, saturated with brine, and that they should be crawling among crystals of sulphate of soda and lime! And what becomes of these worms when, during a long summer, the surface at least is hardened into a solid layer of salt? Flamingoes* in considerable numbers inhabit this lake; they breed here, and their bodies are sometimes found by the workmen, preserved in the salt. I saw several wading about in search of food,—probably for the worms which burrow in the mud; and these latter, perhaps, feed on infusoria or confervæ. Thus we have a little world within itself, adapted to these little inland seas of brine.†

With respect to the geological position of the salinas, they occur either in the plains composed of shingle, and overlying various deposits, or within the grand calcareo-argillaceous formation of the Pampas. The only rule I can discover, is, that they do not occur where the substratum is granitic, as in Brazil and Banda Oriental. I know of their occasional existence over the immense territory extending from lat. 23°, near the Rio Vermejo, to 50° south. The climate may generally be considered as rather dry; at least, such is the case in Patagonia, where the salinas are most numerous. Those which I saw occurred in depressions,

* Throughout South America, the flamingo appears singularly attached to salt lakes. I saw instances of this throughout Patagonia, in the Cordillera of Northern Chile, and at the Galapagos Islands.

† In the Linnæan Transactions, vol. xi., p. 205, a minute crustaceous animal is described, under the name of *Cancer salinus*. It is said to occur in countless numbers in the brine pans at Lymington; but only in those in which the fluid has attained, from evaporation, considerable strength; namely, about a quarter of a pound of salt to a pint of water. This cancer is said, also, to inhabit the salt lakes of Siberia. Well may we affirm, that every part of the world is habitable! Whether lakes of brine, or those subterranean ones hidden beneath volcanic mountains—warm mineral springs; the wide expanse and depths of the ocean; the upper regions of the atmosphere; and even the surface of perpetual snow;—all support organic beings.

whence there was no exit; in a more humid climate the water flowing from the lake would soon have hollowed a channel in the soft strata, and thus converted the depression of the soil into an ordinary valley. There is reason to believe that the whole of these great plains have been raised above the level of the sea within a recent geological period. May we not then consider the salinas as the receptacles of the washings of the sedimentary strata? On this idea we understand their absence where the land is granitic. It is manifest that these great natural evaporating dishes can only occur where the amount of annual rain is small.*

To the northward of the Rio Negro, between it and the inhabited country near Buenos Ayres, the Spaniards have only one small settlement, recently established at Bahia Blanca. The distance in a straight line to the capital is very nearly five hundred British miles. The wandering tribes of horse Indians, which have always occupied the greater part of this country, having of late much harassed the outlying estancias, the government at Buenos Ayres equipped some time since an army under the command of General Rosas for the purpose of exterminating them. The troops were now encamped on the banks of the Colorado; a river lying about eighty miles to the northward of the Rio Negro. When General Rosas left Buenos Ayres, he struck in a direct line across the unexplored plains: and as the country was thus pretty well cleared of Indians, he left behind him, at wide

* Almost every circumstance here mentioned, occurs in the salt lakes near the borders of the Caspian. That country, like Patagonia, appears to have been recently elevated above the waters of the sea. Pallas states that the salt lakes occupy shallow depressions in the steppes; that the mud on the borders in every case is black and fetid; that beneath the crust of sea salt, sulphate of magnesia occurs, imperfectly crystallized; that the muddy sand is mixed with lentils of gypsum. We have before stated that these lakes are inhabited by small crustaceous animals; and flamingoes (Edin. New Philos. Jour., Jan. 1830) likewise frequent them. As these circumstances, apparently so trifling, occur in two distant continents, we may feel sure they are the necessary results of some common cause.—See *Pallas's Travels*, 1793 to 1794, p. 129—134.

intervals, a small party of soldiers, with a troop of horses (a *posta*), so as to be enabled to keep up a communication with the capital. As the Beagle intended to call at Bahia Blanca, I determined to proceed there by land; and ultimately I extended my plan so as to travel the whole way by the postas to Buenos Ayres.

August 11th.—Mr. Harris, an Englishman residing at Patagones, a guide, and five Gauchos, who were proceeding to the army on business, were my companions on the journey. The Colorado, as I have already said, is nearly eighty miles distant: and as we travelled slowly, we were two days and a half on the road. The whole line of country deserves scarcely a better name than that of a desert. Water is found only in two small wells: it is called fresh; but even at this time of the year, during the rainy season, it was quite brackish. In the summer this must be a distressing passage; for now it was sufficiently desolate. The valley of the Rio Negro, broad as it is, has merely been excavated out of the sandstone plain; for immediately above the bank on which the town stands, a level country commences, which is interrupted only by a few trifling valleys and depressions. Every where the landscape wears the same sterile aspect; a dry gravelly soil supports tufts of brown withered grass, and low scattered bushes, armed with thorns.

Shortly after passing the first spring we came in sight of a famous tree, which the Indians reverence as the altar of Walleechu. It is situated on a high part of the plain, and hence is a landmark visible at a great distance. As soon as a tribe of Indians come in sight of it, they offer their adorations by loud shouts. The tree itself is low, much branched, and thorny. Just above the root it has a diameter of about three feet. It stands by itself without any neighbour, and was indeed the first tree we saw; afterwards we met with a few others of the same kind, but they were far from common. Being winter the tree had no leaves, but in their place numberless threads, by which the various offerings, such as cigars, bread, meat, pieces of cloth, &c.,

had been suspended. Poor people not having any thing better, only pulled a thread out of their ponchos, and fastened it to the tree. The Indians, moreover, were accustomed to pour spirits and maté into a certain hole, and likewise to smoke upwards, thinking thus to afford all possible gratification to Walleechu. To complete the scene, the tree was surrounded by the bleached bones of the horses which had been slaughtered as sacrifices. All Indians of every age and sex, made their offerings; they then thought that their horses would not tire, and that they themselves should be prosperous. The Gaucho who told me this, said that in the time of peace he had witnessed this scene, and that he and others used to wait till the Indians had passed by, for the sake of stealing their offerings from Walleechu.

The Gauchos think that the Indians consider the tree as the god itself; but it seems far more probable that they regard it as the altar. The only cause which I can imagine for this choice, is its being a landmark in a dangerous passage. The Sierra de la Ventana is visible at an immense distance; and a Gaucho told me that he was once riding with an Indian a few miles to the north of the Rio Colorado, when the latter commenced making the same loud noise, which is usual at the first sight of the distant tree; putting his hand to his head, and then pointing it in the direction of the Sierra. Upon being asked the reason of this, the Indian said in broken Spanish, "First see the Sierra." This likewise would render it probable that the utility of a distant landmark is the first cause of its adoration. About two leagues beyond this curious tree we halted for the night: at this instant an unfortunate cow was spied by the lynx-eyed Gauchos. Off they set in chase, and in a few minutes she was dragged in by the lazo, and slaughtered. We here had the four necessaries of life "en el campo,"—pasture for the horses, water (only a muddy puddle), meat, and firewood. The Gauchos were in high spirits at finding all these luxuries; and we soon set to work at the poor cow. This was the first night which I had ever passed

under the open sky, with the gear of the recado for my bed. There is high enjoyment in the independence of the Gaucho life—to be able at any moment to pull up your horse, and say, "Here we will pass the night." The deathlike 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 not soon be forgotten.

The next day the country continued similar to that above described. It is inhabited by few birds or animals. Occasionally a deer, or a Guanaco (wild Llama) may be seen; but the Agouti (*Cavia Patagonica*) is the commonest quadruped. This animal here represents our hares. It differs, however, from that genus in many essential respects; for instance, it has only three toes behind. It is also nearly twice the size, weighing from twenty to twenty-five pounds. The Agouti is a true friend to the desert; it is a common feature in the landscape to see two or three hopping quickly one after the other in a straight line across these wild plains. On the eastern side of America their northern limit is formed by the Sierra Tapalguen (lat. 37° 30′), where the plains rather suddenly become greener and more humid. The limit certainly depends on this change, for near Mendoza (lat. 33° 30′), which is much further north, but where the country is very sterile, I again met the Agouti. It is not evident by what circumstances their southern limit is governed; it occurs between Port Desire and St. Julian (about 48° 30′), where there is no change in the kind of land, and only a trifling and gradual one of temperature. It is a singular fact, that although the Agouti is not now found so far south as Port St. Julian, yet that Captain Wood, in his voyage in 1670, talks of them as being numerous there. What cause can have altered, in a wide, uninhabited, and rarely-visited country, the range of an animal like this? It appears, also, from the number shot in one day at Port Desire, that they must have been considerably more abundant there formerly than at present. Azara states that the Agouti never ex-

cavates its own burrow, but uses that of the Bizcacha. Wherever this animal is present, without doubt this is true; but on the sandy plains of Bahia Blanca, where the Bizcacha is not found, the Gauchos maintain that the Agouti is its own workman. The same thing occurs with the little owls of the Pampas (*Noctua cunicularia*), which have so often been described as standing like sentinels at the mouths of the burrows; for in Banda Oriental, owing to the absence of the Bizcacha, they are obliged to hollow out their own habitations. Azara also says that the Agouti, except when pressed by danger, does not enter its burrow: on this point I must again differ from that high authority. At Bahia Blanca I have repeatedly seen two or three of these animals sitting on their haunches by the mouths of their holes, which, as I passed by at a distance, they quietly entered. Daily in the neighbourhood of these spots the Agouti were abundant: but differently from most burrowing animals, it wanders, commonly two or three together, to miles or leagues from its home; nor do I know whether it returns at night. The Agouti feeds and roams about by day; is shy and watchful; does not squat, or so rarely that I never saw an instance of this; it cannot run very fast; and, therefore, is frequently caught by a couple of dogs, even of mixed breed. Its manner of running more resembles that of a rabbit than of a hare. The Agouti generally produces two young ones at a birth, which are brought forth within the burrow. The flesh, when cooked, is very white; it is, however, rather tasteless and dry.

The next morning, as we approached the Rio Colorado, the appearance of the country changed; we soon came on a plain covered with turf, which, from its flowers, tall clover, and little owls, resembled the Pampas. We passed also a muddy swamp of considerable extent, which in summer dries, and becomes incrusted with various salts; and hence is called a salitral. It was covered by low succulent plants, of the same kind with those growing on the sea-shore. The Colorado, at the pass where we crossed it, is only about

sixty yards wide; generally it must be nearly double that width. Its course is very tortuous, being marked by willow-trees and beds of reeds: in a direct line the distance to the mouth of the river is said to be nine leagues, but by water twenty-five. We were delayed crossing in the canoe by some immense troops of mares, which were swimming the river in order to follow a division of troops into the interior. A more ludicrous spectacle I never beheld, than the hundreds of heads, all directed one way, with pointed ears and distended nostrils, appearing just above the water like a great shoal of some amphibious animals. Mare's flesh is the only food which the soldiers have when on an expedition. This gives them a very great facility of movement; for the distance to which horses can be driven over these plains is quite surprising: I have been assured that an unloaded horse can travel a hundred miles a day for many days successively.

The encampment of General Rosas was close to the river. It consisted of a square formed by waggons, artillery, straw huts, &c. The soldiers were nearly all cavalry; and I should think such a villanous, banditti-like army, was never before collected together. The greater number of men were of a mixed breed, between Negro, Indian, and Spaniard. I know not the reason, but men of such origin seldom have a good expression of countenance. I called on the secretary to show my passport. He began to cross-question me in the most dignified and mysterious manner. By good luck I had a letter of recommendation from the government of Buenos Ayres* to the commandant of Patagones. This was taken to General Rosas, who sent me a very obliging message; and the secretary returned all smiles and graciousness. We took up our residence in the *rancho*, or hovel, of a curious old Spaniard, who had served with Napoleon in the expedition against Russia.

We staid two days at the Colorado; I had little to do, for

* I am bound to express, in the strongest terms, my obligation to the Government of Buenos Ayres for the obliging manner in which passports to all parts of the country were given me, as naturalist of the Beagle.

the surrounding country was a swamp, which in summer, (December) when the snow melts on the Cordillera, is overflowed by the river. My chief amusement was watching the Indian families as they came to buy little articles at the rancho, where we staid. It was supposed that General Rosas had about six hundred Indian allies. The men were a tall, fine race, yet it was afterwards easy to see in the Fuegian savage the same countenance rendered hideous by cold, want of food, and less civilization. Some authors, in defining the primary races of mankind, have separated these Indians into two classes; but I cannot think this is correct. Among the young women or chinas, some deserve to be called even beautiful. Their hair was coarse, but bright and black; and they wore it in two plaits hanging down to the waist. They had a high colour, and eyes that glistened with brilliancy; their legs, feet, and arms were small and elegantly formed; their ankles, and sometimes their waists, were ornamented by broad bracelets of blue beads. Nothing could be more interesting than some of the family groups. A mother with one or two daughters would often come to our rancho, mounted on the same horse. They ride like men, but with their knees tucked up much higher. This habit, perhaps, arises from their being accustomed, when travelling, to ride the loaded horses. The duty of the women is to load and unload the horses; to make the tents for the night; in short to be, like the wives of all savages, useful slaves. The men fight, hunt, take care of the horses, and make the riding gear. One of their chief indoor occupations is to knock two stones together till they become round. The bolas is a very important weapon to the Indian; for with it he catches his game, and also his horse which roams free over the plain. In fighting, his first attempt is to throw the horse of his adversary with the bolas, and when entangled by the fall to kill him with the chuzo. If the balls only catch the neck or body of an animal, they are often carried away and lost. As the making the stones round is the labour of two days, the manufacture of the balls is a very common employment.

Several of the men and women had their faces painted red, but I never saw the horizontal bands which are so common among the Fuegians. Their chief pride consists in having every thing made of silver; I have seen a cacique with his spurs, stirrups, handle of his knife, and bridle made of this metal: the head-stall and reins being of wire, were not thicker than whipcord; and to see a fiery steed, wheeling about under the command of so light a chain, gave to the horsemanship a remarkable character of elegance.

General Rosas intimated a wish to see me; a circumstance which I was afterwards very glad of. He is a man of an extraordinary character, and has a most predominant influence in the country, which it seems probable he will use to its prosperity and advancement. He is said to be the owner of seventy-four square leagues of land, and to have about three hundred thousand head of cattle. His estates are admirably managed, and are far more productive of corn than any others. He first gained his celebrity by his laws for his own estancias, and by disciplining several hundred men, so as to resist with success the attacks of the Indians. There are many stories current about the rigid manner in which his laws were enforced. One of these was, that no man, on penalty of being put into the stocks, should carry his knife on a Sunday: this day being the principal one for gambling and drinking, many quarrels arose, which from the general manner of fighting with the knife often proved fatal. One Sunday the Governor came in great form to pay the Estancia a visit, and General Rosas, in his hurry, walked out to receive him with his knife, as usual, stuck in his belt. The steward touched his arm, and reminded him of the law; upon which turning to the Governor, he said he was extremely sorry, but that he must go into the stocks, and that till let out, he possessed no power even in his own house. After a little time the steward was persuaded to open the stocks, and to let him out, but no sooner was this done, than he turned to the steward and said, "You now have broken the laws, so you must take my place in the stocks."

Such actions as these delighted the Gauchos, who all possess high notions of their own equality and dignity.

General Rosas is also a perfect horseman—an acomplishment of no small consequence in a country where an assembled army elected its general by the following trial: A troop of unbroken horses being driven into a corral, were let out through a gateway, above which was a cross-bar: it was agreed, whoever should drop from the bar on one of these wild animals, as it rushed out, and should be able without saddle or bridle, not only to ride it, but also to bring it back to the door of the corral, should be their general. The person who succeeded was accordingly elected; and doubtless made a fit general for such an army. This extraordinary feat has also been performed by Rosas.

By these means, and by conforming to the dress and habits of the Gauchos, he has obtained an unbounded popularity in the country, and in consequence a despotic power. I was assured by an English merchant, that a man who had murdered another, when arrested and questioned concerning his motive, answered, "He spoke disrespectfully of General Rosas, so I killed him." At the end of a week the murderer was at liberty. This doubtless was the act of the general's party, and not of the general himself.

In conversation he is enthusiastic, sensible, and very grave. His gravity is carried to a high pitch: I heard one of his mad buffoons (for he keeps two, like the barons of old) relate the following anecdote: "I wanted very much to hear a certain piece of music, so I went to the general two or three times to ask him; he said to me, 'Go about your business, for I am engaged.' I went a second time; he said, 'If you come again I will punish you.' A third time I asked, and he laughed. I rushed out of the tent, but it was too late; he ordered two soldiers to catch and stake me. I begged by all the Saints in heaven, he would let me off; but it would not do;—when the general laughs he spares neither mad man or sound." The poor flighty gentleman looked quite dolorous, at the very recollection of the staking. This

is a very severe punishment; four posts are driven into the ground, and the man is extended by his arms and legs horizontally, and there left to stretch for several hours. The idea is evidently taken from the usual method of drying hides. My interview passed away without a smile, and I obtained a passport and order for the government post-horses, and this he gave me in the most obliging and ready manner.

In the morning we started for Bahia Blanca, which we reached in two days. Leaving the regular encampment, we passed by the toldos of the Indians. These are round like ovens, and covered with hides; by the mouth of each a tapering chuzo was stuck in the ground. The toldos were divided into separate groups, which belonged to the different caciques' tribes, and the groups were again divided into smaller ones, according to the relationship of the owners. For several miles we travelled along the valley of the Colorado. The alluvial plains on the side appeared fertile, and it is supposed that they are well adapted to the growth of corn. Turning northward from the river, we soon entered on a country, differing from those plains that extend south of the river. The land still continued dry and sterile; but it supported many different kinds of plants, and the grass, though brown and withered, was more abundant, as the thorny bushes were less so. These latter in a short space entirely disappeared, and the plains were left without a thicket to cover their nakedness. This change in the vegetation marks the commencement of the grand calcareo-argillaceous deposit, which I have already noticed as forming the wide extent of the Pampas, and as covering the granitic rocks of Banda Oriental. From the Strait of Magellan to the Colorado, a distance of about eight hundred miles, the face of the country is every where composed of shingle: the pebbles are chiefly of porphyry, and probably owe their origin to the rocks of the Cordillera. North of the Colorado the bed thins out, and the pebbles become exceedingly small, and here the characteristic vegetation of Patagonia ceases.

Having ridden about twenty-five miles, we came to a broad belt of sand-dunes, which stretch, as far as the eye can reach, to the east and west. The sand-hillocks resting on the clay, allow small pools of water to collect, and thus afford, in this dry country, an invaluable supply of fresh water. The great advantage arising from depressions and elevations of the soil, is not often brought home to the mind. The two miserable springs in the long passage between the Rio Negro and Colorado were caused by trifling inequalities in the plain; without them not a drop of water would have been found. The belt of sand-dunes is about eight miles wide; at some former period, it probably formed the margin of a grand estuary, where the Colorado now flows. In this district, where absolute proofs of the recent elevation of the land occur, such speculations can hardly be neglected by any one, although merely considering the physical geography of the country. Having crossed the sandy tract, we arrived in the evening at one of the post-houses; and, as the fresh horses were grazing at a distance, we determined to pass the night there.

The house was situated at the base of a ridge, between one and two hundred feet high—a most remarkable feature in this country. This posta was commanded by a negro lieutenant, born in Africa: to his credit be it said, there was not a rancho between the Colorado and Buenos Ayres in nearly such neat order as his. He had a little room for strangers, and a small corral for the horses, all made of sticks and reeds; he had also dug a ditch round his house, as a defence in case of being attacked. This would, however, have been of little avail, if the Indians had come; but his chief comfort seemed to rest in the thought of selling his life dearly. A short time before, a body of Indians had travelled past in the night; if they had been aware of the posta, our black friend and his four soldiers, would assuredly have been slaughtered. I did not any where meet a more civil and obliging man, than this negro; it was therefore the more painful to see that he would not sit down and eat with us.

In the morning we sent for the horses very early, and started for another exhilarating gallop. We passed the Cabeza del Buey, an old name given to the head of a large marsh, which extends from Bahia Blanca. Here we changed horses, and passed through some leagues of swamps and saltpetre marshes. Changing horses for the last time, we again began wading through the mud. My animal fell, and I was well soused in black mire—a very disagreeable accident, when one does not possess a change of clothes. Some miles from the fort we met a man, who told us that a great gun had been fired, which is a signal that Indians are near. We immediately left the road, and followed the edge of a marsh, which when chased offers the best mode of escape. We were glad to arrive within the walls, when we found all the alarm was about nothing, for the Indians turned out to be friendly ones, who wished to join General Rosas.

Bahia Blanca scarcely deserves the name of a village. A few houses and the barracks for the troops are enclosed by a deep ditch and fortified wall. The settlement is only of recent standing (since 1828); and its growth has been one of trouble. The government of Buenos Ayres did not follow the wise example of the Spanish viceroys in purchasing the land from the Indians, as they did with the Rio Negro, but unjustly occupied it by force. Hence the need of the fortifications; hence the few houses and little cultivated land without the limits of the walls: even the cattle are not safe from the attacks of the Indians beyond the boundaries of the plain, on which the fortress stands.

The part of the harbour where the Beagle intended to anchor being distant twenty-five miles, I obtained from the Commandant a guide and horses, to take me to see whether she had arrived. Leaving the plain of green turf, which followed the course of the little brook, we soon entered on a wide level waste, consisting either of sand, saline marshes, or bare mud. Some parts were clothed by low thickets, and others with those succulent plants, which luxuriate only

where salt abounds. Bad as the country was, ostriches, deer, cavies, and armadilloes, were abundant. My guide told me, that two months before he had a most narrow escape of his life: he was out hunting, at no great distance from this part of the country, with two other men, when they were suddenly met by a party of Indians, who giving chase, soon overtook and killed his two friends. His own horse's legs were also caught by the bolas; but he jumped off, and with his knife cut them free: while doing this he was obliged to dodge round his horse, and received two severe wounds from their chuzos. Springing on the saddle, he managed, by a most wonderful exertion, just to keep ahead of the long spears of his pursuers, who followed him to within sight of the fort. From that time there was an order that no one should stray far from the settlement. I did not know of this when I started, and was surprised to observe how earnestly my guide watched a deer, which appeared to have been frightened from a distant quarter.

We found the Beagle had not arrived, and consequently set out on our return, but the horses soon tiring, we were obliged to bivouac on the plain. In the morning we had caught an armadillo, which, although a most excellent dish when roasted in its shell, did not make a very substantial breakfast and dinner for two hungry men. The ground at the place where we stopped for the night, was incrusted with a layer of Glauber salt, and hence, of course, was without water. Yet many of the smaller rodents managed to exist even here, and the tucutuco was making its odd little grunt beneath my head, during half the night. Our horses were very poor ones, and in the morning they were soon exhausted from not having had any thing to drink, so that we were obliged to walk. About noon the dogs killed a kid, which we roasted. I eat some of it, but it made me intolerably thirsty. This was the more distressing as the road, from some recent rain, was full of little puddles of clear water, yet not a drop was drinkable. I had scarcely

been twenty hours without water, and only part of the time under a hot sun, yet the thirst rendered me very weak. How people survive two or three days under such circumstances, I cannot imagine: at the same time, I must confess that my guide did not suffer at all, and was astonished that one day's deprivation should be so troublesome to me.

I have several times alluded to the surface of the ground being incrusted with salt. This phenomenon is quite different from that of the salinas, and much more extraordinary. In many parts of South America, wherever the climate is moderately dry, these incrustations occur; but I have nowhere seen them so abundant as near Bahia Blanca. The salt here consists of a large proportion of sulphate of soda mixed with a very little of the common muriate. As long as the ground remains moist in these salitrales (as the Spaniards improperly call them, mistaking this substance for saltpetre), nothing is to be seen but an extensive plain composed of a black, muddy soil, supporting scattered tufts of succulent plants. I was therefore much surprised, after a week's hot weather, when I first saw square miles of country, that I had previously ridden over in the former condition, white, as if from a slight fall of snow which the wind had heaped up into partial drifts. This latter appearance is chiefly due to the tendency which the salt has to crystallize, like hoar-frost, round the blades of grass, stumps of wood, or on the top of the broken ground, in lieu of the bottoms of the puddles of water. The salinas, as a general rule, occur in depressions on the more elevated plains; the salitrales, either on level tracts elevated a few feet above the level of the sea, and appearing as if lately inundated, or on alluvial land bordering rivers. In this latter case, although I am not absolutely certain, I have strong reasons for believing that the salt is often removed by the waters of the river, and is again reproduced. Several circumstances incline me to think that the black, muddy soil, generates the sulphate of soda. The whole phenomenon is well worthy the

attention of naturalists: what can be more singular than thus to see square miles of country thinly crusted over with Glauber salt? It may be asked whether plants do not decompose the muriate of soda? but whence comes the sulphuric acid? In Peru, nitrate of soda occurs in beds far thicker than these of the sulphate. Both cases are equally mysterious. I suspect that, as a general rule, the salts of soda are infinitely more common in South America than those of potash.

Two days afterwards, I again rode to the harbour, but to a nearer part of it. When not far from our destination, my companion, the same man as before, spied three people hunting on horseback. He immediately dismounted, and watching them intently, said, "They don't ride like Christians, and nobody can leave the fort." The three hunters joined company, and likewise dismounted from their horses. At last one mounted again and rode over the hill out of sight. My companion said, "We must now get on our horses: load your pistol;" and he looked to his own sword. I asked, "Are they Indians?"—"Quien sabe? (who knows?) if there are no more than three, it does not signify." It then struck me, that the one man had gone over the hill to fetch the rest of his tribe. I suggested this; but all the answer I could extort was, "Quien sabe?" His head and eye never for a minute ceased scanning slowly the distant horizon. I thought his uncommon coolness too good a joke, and asked him why he did not return home. I was startled when he answered, "We are returning, but in a line so as to pass near a swamp, into which we can gallop the horses as far as they can go, and then trust to our own legs; so that there is no danger." I did not feel quite so confident of this, and wanted to increase our pace. He said, "No, not until they do." When any little inequality concealed us, we galloped; but when in sight continued walking. At last we reached a valley, and turning to the left, galloped quickly to the foot of a hill, he gave me his horse to hold, made the dogs lie down, and then crawled on his hands and knees to reconnoitre. He re-

mained in this position for some time, and at last, bursting out in laughter, exclaimed, "Mugeres!" (women!) He knew them to be the wife and sister-in-law of the major's son, hunting for ostrich's eggs. I have described this man's conduct, because he acted under the full impression that they were Indians. As soon, however, as the absurd mistake was found out, he gave me a hundred reasons, why they could not have been Indians; but all these were forgotten at the time. We then rode on in peace and quietness to a low point called Punta Alta, whence we could see nearly the whole of the great harbour of Bahia Blanca.

The wide expanse of water is choked up by numerous great mud-banks, which the inhabitants call Cangrejales, or *crabberies*, from the number of small crabs. The mud is so soft, that it is impossible to walk over them, even for the shortest distance. Many of the banks have their surfaces covered with long rushes, the tops of which alone are visible at high water. On one occasion, when in a boat, we were so entangled by these shallows, that we could hardly find our way. Nothing was visible, but the flat beds of mud: the day was not very clear, and there was much refraction, or as the sailors expressed it, "things loomed high." The only object within our view, which was not level, was the horizon; rushes looked like bushes unsupported in the air, and water like mud-banks, and mud-banks like water.

We passed the night in Punta Alta, and I employed myself in searching for fossil bones; this point, being a perfect catacomb for monsters of extinct races. The evening was perfectly calm and clear; the extreme monotony of the view gave it an interest, even in the midst of mud-banks and gulls, sand-hillocks, and solitary vultures. In riding back in the morning, we came across a very fresh track of a Puma, but did not succeed in finding him. We saw also a couple of Zorillos, or skunks,—odious animals, which are far from uncommon. In general appearance the Zorillo resembles a polecat, but it is rather larger, and much thicker in proportion. Conscious of its power, it roams by day about

the open plain, and fears neither dog nor man. If a dog is urged to the attack, its courage is instantly checked by a few drops of the fetid oil, which brings on violent sickness and running at the nose. Whatever is once polluted by it, is for ever useless. Azara says the smell can be perceived at a league distant; more than once, when entering the harbour of Monte Video, the wind being off shore, we have perceived the odour on board the Beagle. Certain it is, that every animal most willingly makes room for the Zorillo.

CHAPTER V.

Bahia Blanca — Geology — Extinct quadrupeds, four Edentata, horse, ctenomys—Recent extinction—Longevity of species—Large animals do not require luxuriant vegetation—Southern Africa—Siberian fossils—Catalogue of extinct quadrupeds in South America—Two species of Ostrich, habits of—Tinochorus—Oven-bird—Armadilloes—Venomous snake, toad, lizard—Hybernation of animals—Habits of sea-pen—Indian wars and massacres—Arrow-head, antiquarian relic.

BAHIA BLANCA.

The Beagle arrived on the 24th of August, and a week afterwards sailed for the Plata. With Captain Fitzroy's consent I was left behind, to travel by land to Buenos Ayres. I will here add some observations, which were made during this visit, and on a previous occasion, when the Beagle was employed in surveying the harbour. Not much can be made out respecting the geology. At the distance of some miles inland, an escarpment of a great argillaceo-calcareous formation of rock extends. The space near the coast consists of plains of hardened mud, and broad bands of sand-dunes, which present appearances, that can easily be accounted for by a rise of the land; and of this phenomenon,* although to a trifling amount, we have other proofs.

At Punta Alta, a low cliff, about twenty feet high, exposes a mass of partly consolidated shingle, irregularly interstratified with a reddish muddy clay, and containing numerous recent shells. We may believe a similar accumulation would now take place, on any point, where tides and waves were opposed. In the gravel a considerable number of bones were embedded. Mr. Owen, who has undertaken the description of these remains, has not yet examined them

* A few leagues further south, near the Bay of San Blas, M. D'Orbigny found great beds of recent shells elevated between 25 and 30 feet above the level of the sea.—Vol. ii., p. 43.

with care; but the following list may give some idea of their nature: 1st, a tolerably perfect head of a megatherium, and a fragment and teeth of two others; 2d, an animal of the order Edentata, as large as a pony, and with great scratching claws; 3d and 4th, two great Edentata related to the megatherium, and both fully as large as an ox or horse; 5th, another equally large animal, closely allied or perhaps identical with the Toxodon (hereafter to be described), which had very flat grinding teeth, somewhat resembling those of a rodent; 6th, a large piece of the tesselated covering like that of the armadillo, but of gigantic size; 7th, a tusk which in its prismatic form, and in the disposition of the enamel, closely resembles that of the African boar; it is probable that it belonged to the same animal with the singular flat grinders. Lastly, a tooth in the same state of decay with the others: its broken condition does not allow Mr. Owen, without further comparison, to come to any definite conclusion; but the part that is perfect, resembles in every respect the tooth of the common horse.* All these remains were found embedded in a beach which is covered at spring tides; and the space in which they were collected could not have exceeded one hundred and fifty yards square. It is a remarkable circumstance that so many different species should be found together; and it proves how numerous in kind the ancient inhabitants of this country must have been.

At the distance of about thirty miles, in another cliff of red earth, I found several fragments of bones. Among them were the teeth of a rodent, much narrower, but even larger than those of the *Hydrochœrus capybara;* the animal which has been mentioned as exceeding in dimensions every existing member of its order. There was

* With respect to the remains of the last animal, as some doubt may be entertained by others, respecting its origin; it must be remarked, that it was fairly embedded in the gravel with the other bones; and that its state of decay was equal. To this circumstance it may be added, that the surrounding country is without fresh water, and is uninhabited, and that the settlement, itself only of five years standing, is twenty-five miles distant.

also part of the head of a Ctenomys; the species being different from the Tucutuco, but with a close general resemblance.

The remains at Punta Alta were associated, as before remarked, with shells of existing species. These have not as yet been examined with scrupulous care, but it may be safely asserted, that they are most closely similar to the species now living in the same bay: it is also very remarkable, that not only the species, but the proportional numbers of each kind, are nearly the same with those now cast up on the pebble beaches. There are eleven marine species (some in an imperfect state), and one terrestrial. If I had not collected living specimens from the same bay, some of the fossils would have been thought extinct; for Mr. Sowerby, who was kind enough to look at my collection, had not previously seen them. We may feel certain that the bones have not been washed out of an older formation, and embedded in a more recent one, because the remains of one of the Edentata were lying in their proper relative position (and partly so in a second case); which could not have happened, without the carcass had been washed to the spot where the skeleton is now entombed.

We here have a strong confirmation of the remarkable law so often insisted on by Mr. Lyell, namely, that the "longevity of the species in the mammalia, is upon the whole inferior to that of the testacea."* When we proceed to the southern part of Patagonia, I shall have occasion to describe the case of an extinct camel, from which the same result may be deduced.

From the shells being littoral species (including one terrestrial), and from the character of the deposit, we may feel absolutely certain that the remains were embedded in a shallow sea, not far from the coast. From the position of the skeleton being undisturbed, and likewise from the fact that full-grown serpulæ were attached to some of the bones,

* Principles of Geology, vol. iv., p. 40.

we know that the mass could not have been accumulated on the beach itself. At the present time, part of the bed is daily washed by the tide, while another part has been raised a few feet above the level of the sea. Hence we may infer, that the elevation has here been trifling, since the period when the mammalia, now extinct, were living. This conclusion is in harmony with several other considerations (such as the recent character of the beds underlying the Pampas deposit), but which I have not space in this work to enter on.

From the general structure of the coast of this part of South America, we are compelled to believe, that the changes of level have all (at least of late) been in one direction, and that they have been very gradual. If, then, we look back to the period when these quadrupeds lived, the land probably stood at a level, less elevated only by a few fathoms than at present. Therefore, its general configuration since that epoch cannot have been greatly modified; a conclusion which certainly would be drawn from the close similarity in every respect, between the shells now living in the bay (as well as in the case of the one terrestrial species) with those which formerly lived there.

The surrounding country, as may have been gathered from this journal, is of a very desert character. Trees nowhere occur, and only a few bushes, which are chiefly confined to depressions among the sand-hillocks, or to the borders of the saline marshes. Here, then, is an apparent difficulty: we have the strongest evidence that there has occurred no great physical change to modify the features of the country, yet in former days, numerous large animals were supported on the plains now covered by a thin and scanty vegetation.

That large animals require a luxuriant vegetation, has been a general assumption, which has passed from one work to another. I do not hesitate, however, to say that it is completely false; and that it has vitiated the reasoning of geologists, on some points of great interest in the ancient history of the world. The prejudice has probably been derived

from India, and the Indian islands, where troops of elephants, noble forests, and impenetrable jungles, are associated together in every account. If, on the other hand, we refer to any work of travels through the southern parts of Africa, we shall find allusions in almost every page either to the desert character of the country, or to the numbers of large animals inhabiting it. The same thing is rendered evident by the many sketches which have been published of various parts of the interior. When the Beagle was at Cape Town, I rode a few leagues into the country, which at least was sufficient to render that which I had read more fully intelligible.

Dr. Andrew Smith, who, at the head of his adventurous party, has so lately succeeded in passing the Tropic of Capricorn, informs me that, taking into consideration the whole of the southern part of Africa, there can be no doubt of its being sterile country. On the southern and south-eastern coasts there are some fine forests, but with these exceptions, the traveller may pass, for days together, through open plains, covered by a poor and scanty vegetation. It is difficult to convey any accurate idea of degrees of comparative fertility; but it may be safely said, that the amount of vegetation supported at any one time* by Great Britain, exceeds, perhaps even tenfold, the quantity on an equal area, in the interior parts of Southern Africa. The fact that bullock-waggons can travel in any direction, excepting near the coast, without more than occasionally half an hour's delay, gives, perhaps, a more definite notion of its scantiness. Now if we look to the animals inhabiting these wide plains, we shall find their numbers extraordinarily great, and their bulk immense. We must enumerate the elephant, three species of rhinoceros, and as Dr. Smith is convinced two others also, the hippopotamus, giraffe, the bos caffer—as large as a full-grown bull, and the elan—but little less, two

* I mean by this to exclude the total amount, which may have been successively produced and consumed during a given period.

zebras, and the quaccha, two gnus, and several antelopes even larger than these latter animals. It may be supposed that although the species are numerous, the individuals of each kind are few. By the kindness of Dr. Smith, I am enabled to show that the case is very different. He informs me, that in lat. 24°, in one day's march with the bullock-waggons, he saw, without wandering to any great distance on either side, between one hundred and one hundred and fifty rhinoceroses, which belonged to three species. That the same day he saw several herds of giraffes, amounting together to nearly a hundred; and that, although no elephant was observed, yet they are found in this district. At the distance of a little more than one hour's march from their place of encampment on the previous night, his party actually killed at one spot eight hippopotamoses, and saw many more. In this same river there were likewise crocodiles. Of course it was a case quite extraordinary, to see so many great animals crowded together, but it evidently proves that they must exist in great numbers. Dr. Smith describes the country passed through that day, as "being thinly covered with grass, and bushes about four feet high, and still more thinly with mimosa-trees." The waggons were not prevented travelling in a nearly direct line.

Besides these large animals, every one the least acquainted with the natural history of the Cape, has read of the herds of antelopes, which can be compared only to flocks of migratory birds. The numbers indeed of the lion,* panther, and hyæna, and the multitude of birds of prey, plainly tell of the abundance of the smaller quadrupeds. As Dr. Smith remarked to me, the carnage each day in Southern Africa must indeed be terrific! I confess it is truly surprising, how such a number of animals can find support in a country producing so little food. The larger quadrupeds no doubt roam over wide extents in search of it; and their food chiefly con-

* Dr. Smith mentioned to me, that one evening seven lions were counted at one time walking on the plain, round the encampment.

sists of underwood, which probably contains much nutriment in a small bulk. Dr. Smith also informs me that the vegetation has a rapid growth; no sooner is a part consumed, than its place is supplied by a fresh stock. I apprehend, however, that our ideas respecting the quantity necessary for the support of large quadrupeds are exaggerated. It should have been remembered that the camel, an animal of no mean bulk, has always been considered as the emblem of the desert.

The belief that where large quadrupeds exist, the vegetation must necessarily be luxuriant, is the more remarkable, because the converse is far from true. Mr. Burchell observed to me that when entering Brazil, nothing struck him more forcibly than the splendour of the South American vegetation, contrasted with that of South Africa, together with the absence of all large quadrupeds. In his Travels,* he has suggested that the comparison of the respective weights (if there were sufficient data) of an equal number of the largest herbivorous quadrupeds of each country would be extremely curious. If we take on the one side the elephant,† hippopotamus, giraffe, bos caffer, elan, certainly three species of rhinoceros, and probably five; and on the

* Travels in the interior of South Africa, vol. ii., p. 207.

† The elephant which was killed at Exeter Change, was estimated (being partly weighed) at five tons and a half. The elephant actress, as I was informed, weighed one ton less; so that we may take five as the average of a full-grown elephant. I was told at the Surrey Gardens, that a hippopotamus which was sent to England cut up into pieces, was estimated at three tons and a half; we will call it three. From these premises we may give three tons and a half to each of the five rhinoceroses; perhaps a ton to the giraffe, and half to the bos caffer as well as the elan, (a large ox weighs from 1200 to 1500 pounds). This will give an average (from the above conjectures) of 2.7 of a ton for the ten largest herbivorous animals of Southern Africa. In South America, allowing 1200 pounds for the two tapirs together, 550 for the guanaco and vicuna, 500 for three deer, 300 for capybara, peccari, and a monkey, we shall have an average of 250 pounds, which I believe is overstating the result. The ratio will therefore be, as 6048 to 250, for the ten largest animals from the two countries.

other side, two tapirs, the guanaco, three deer, the vicuna, peccari, capybara (after which we must choose from the monkeys to complete the number), and then place these two groups alongside each other, it is not easy to conceive ranks more disproportionate. After the above facts, we are compelled to conclude, against anterior probability,* that among the mammalia there exists no close relation between the *bulk* of the species, and the *quantity* of the vegetation, in the countries they inhabit.

With regard to the number of large quadrupeds, there certainly exists no quarter of the globe which will bear comparison with Southern Africa. After the different statements which have been given, the extremely desert character of that region will not be disputed. In the European division of the world, we must look back to the tertiary epochs, to find a condition of things among the mammalia resembling that which is now found at the Cape of Good Hope. That tertiary epoch, which we are apt to consider as abounding to an astonishing degree with large animals, because we find the remains of many ages accumulated at certain spots, could boast of but few more of the large quadrupeds, than Southern Africa does at present. If we speculate on the condition of the vegetation during that epoch, we are at least bound so far to consider existing analogies, as not to urge as absolutely necessary a luxuriant vegetation, when we see a state of things so totally different in the region to which we refer.

We know† that the extreme regions of North America,

* If we suppose the case of the discovery of a skeleton of a Greenland whale in a fossil state, not a single cetaceous animal being known to exist, what naturalist would even conjecture on the possibility of a carcass so gigantic, being supported on the minute crustacea and mollusca, living in the frozen seas of the extreme North?

† See Zoological Remarks to Capt. Back's Expedition, by Dr. Richardson. He says, "The subsoil north of latitude 56° is perpetually frozen, the thaw on the coast not penetrating above three feet, and at Bear Lake, in latitude 64°, not more than twenty inches. The frozen substratum does not of itself destroy vegetation, for forests flourish on the surface, at a distance from the coast."

many degrees beyond the limit where the ground at the depth of a few feet remains perpetually congealed, are covered by forests of large and tall trees. In a like manner, in Siberia, we have woods of birch, fir, aspen, and larch, growing in a latitude* (64°), where the mean temperature of the air falls below the freezing point, and where the earth is so completely frozen, that the carcass of an animal embedded in it is perfectly preserved. With these facts we must grant, as far as *quantity alone* of vegetation is concerned, that the great quadrupeds of the later tertiary epochs might, in most parts of Northern Europe and Asia, have lived on the spots where their remains are now found. I do not here speak of the *kind* of vegetation necessary for their support; because, as there is evidence of physical changes, and as the animals have become extinct, so may we suppose that the species of plants have likewise been changed.

These remarks directly bear on the case of the Siberian animals preserved in ice. The firm conviction of the necessity of a vegetation, possessing a character of tropical luxuriance, to support such large animals, and the impossibility of reconciling this with the proximity of perpetual congelation, was one chief cause of the several theories of sudden revolutions of climate, and of overwhelming catastrophes, which were invented to account for their entombment. I am far from supposing that the climate has not changed since the period when those animals lived, which now lie buried in the ice. At present I only wish to show, that as far as *quantity* of food *alone* is concerned, the ancient rhinoceroses might have roamed over the *steppes* of central Siberia (the northern parts probably being under water) even in their present condition, as well as the living rhi-

* See Humboldt Fragmens Asiatiques, p. 386: Barton's Geography of Plants: and Malte Brun. In the latter work it is said, that the limit of the growth of trees in Siberia may be drawn under the parallel of 70°.

noceroses and elephants over the *Karros* of Southern Africa.

After our long digression, if we return to the case of the fossil animals at Bahia Blanca, there is a difficulty from our not knowing on what food the great Edentata probably lived. If on insects and larvæ, like their nearest representatives the armadilloes and anteaters, there is an end to all conjecture. But as vegetation is the first source of life in every part of the world, I think we may safely conclude that the country around Bahia Blanca, with a very little increase of fertility, would support large animals. The plains of the Rio Negro, thickly scattered over with thorny bushes, I do not doubt would supply sufficient food equally well with the *Karros* of Africa. As there is evidence of a physical change to a small amount, so may we allow it to be probable that the productiveness of the soil has decreased in an equally small degree. With this concession I apprehend every difficulty is removed. On the other hand, if we imagine a luxuriant vegetation to be necessary for the support of these animals, we become involved in a series of contradictions and improbabilities.

As the notices of the remains of several quadrupeds, which I discovered in South America, are scattered in different parts of this volume, I will here give a catalogue of them. After having enlarged on the diminutive size of the present races, it may be of interest to see that formerly a very different order of things prevailed. First, the megatherium, and the four or five other large edentata, already alluded to; 6th, an immense mastodon, which must have abounded over the whole country; 7th, the horse (I do not now refer to the broken tooth at Bahia Blanca, but to more certain evidence); 8th, the toxodon, an extraordinary animal as large as a hippopotamus; 9th, a fragment of the head of an animal larger than a horse, and of a very singular character; 10th, 11th, and 12th, parts of rodents—one of considerable size; lastly, a llama or *guanaco*, fully as large as the camel. All these animals coexisted during an epoch

which, geologically speaking is so recent, that it may be considered as only just gone by. These remains have been presented to the College of Surgeons, where they are now in the hands of those best qualified to appreciate whatever value they may possess.

I will now give an account of the habits of some of the more interesting birds, which are common on these wild plains; and first of the *Struthio Rhea*, or South American ostrich. This bird is well known to abound over the plains of Northern Patagonia, and the united provinces of La Plata. It has not crossed the Cordillera; but I have seen it within the first range of mountains on the Uspallata plain, elevated between six and seven thousand feet. The ordinary habits of the ostrich are familiar to every one. They feed on vegetable matter; such as roots and grass; but at Bahia Blanca, I have repeatedly seen three or four come down at low water to the extensive mud-banks which are then dry, for the sake, as the Gauchos say, of catching small fish. Although the ostrich in its habits is so shy, wary, and solitary, and although so fleet in its pace, it falls a prey, without much difficulty, to the Indian or Gaucho armed with the bolas. When several horsemen appear in a semicircle, it becomes confounded, and does not know which way to escape. They generally prefer running against the wind; yet at the first start they expand their wings, and like a vessel make all sail. On one fine hot day I saw several ostriches enter a bed of tall rushes, where they squatted concealed, till quite closely approached. It is not generally known that ostriches readily take to the water. Mr. King informs me that at the Bay of San Blas, and at Port Valdes in Patagonia, he saw these birds swimming several times from island to island. They ran into the water both when driven down to a point, and likewise of their own accord when not frightened: the distance crossed was about 200 yards. When swimming, very little of their bodies appear above water, and their necks are extended a little forward: their progress is slow. On two occasions, I saw some ostriches swimming across the Santa

Cruz river, where its course was about four hundred yards wide, and the stream rapid. Captain Sturt, when descending the Murrumbidgee, in Australia, saw two emus in the act of swimming.

The inhabitants who live in the country readily distinguish, even at a distance, the cock bird from the hen. The former is larger and darker-coloured,* and has a bigger head. The ostrich, I believe the cock, emits a singular deep-toned, hissing note. When first I heard it, standing in the midst of some sand-hillocks, I thought it was made by some wild beast, for it is a sound that one cannot tell whence it comes, or from how far distant. When we were at Bahia Blanca in the months of September and October, the eggs, in extraordinary numbers, were found all over the country. They either lie scattered single, in which case they are never hatched, and are called by the Spaniards, huachos; or they are collected together into a shallow excavation, which forms the nest. Out of the four nests which I saw, three contained twenty-two eggs each, and the fourth twenty-seven. In one day's hunting on horseback sixty-four eggs were found; forty-four of these were in two nests, and the remaining twenty scattered huachos. The Gauchos unanimously affirm, and there is no reason to doubt their statement, that the male bird alone hatches the eggs, and for some time afterwards accompanies the young. The cock when on the nest lies very close; I have myself almost ridden over one. It is asserted that at such times they are occasionally fierce, and even dangerous, and that they have been known to attack a man on horseback, trying to kick and leap on him. My informer pointed out to me an old man, whom he had seen much terrified by one chasing him. I observe in Burchell's travels in South Africa, that he remarks, "having killed a male ostrich, and the feathers being dirty, it was said by the Hottentots to be a nest bird." I understand that the

* A Gaucho assured me, that he had once seen a snow-white, or Albino variety, and that it was a most beautiful bird.

male emu, in the Zoological Garden, takes charge of the nest: this habit, therefore, is common to the family.

The Gauchos unanimously affirm that several females lay in one nest. I have been positively told, that four or five hen birds have been seen to go, in the middle of the day, one after the other, to the same nest. I may add, also, that it is believed in Africa, that two females lay in one nest.* Although this habit at first appears very strange, I think the cause may be explained in a simple manner. The number of eggs in the nest varies from twenty to forty, and even to fifty; and according to Azara to seventy or eighty. Now although it is most probable, from the number of eggs found in one district being so extraordinarily great, in proportion to that of the parent birds, and likewise from the state of the ovarium of the hen, that she may in the course of the season lay a large number, yet the time required must be very long. Azara states,† that a female in a state of domestication laid seventeen eggs, each at the interval of three days one from another. If the hen were obliged to hatch her own eggs, before the last was laid the first probably would be addled; but if each laid a few eggs at successive periods, in different nests, and several hens, as is stated to be the case, combined together, then the eggs in one collection would be nearly of the same age. If the number of eggs in one of these nests is, as I believe, not greater on an average than the number laid by one female in the season, then there must be as many nests as females, and each cock bird will have its fair share of the labour of incubation; and that during a period when the females could not sit, on account of not having finished laying. I have before mentioned the great numbers of huachos, or scattered eggs; so that in one day's hunting the third part were found in this state. It appears odd that so many should be wasted. Does it not arise from the difficulty of several females associating together, and persuading an old cock to undertake the office

* Burchell's Travels, vol. i., p. 280. † Azara, vol. iv., p. 173.

of incubation? It is evident that there must at first be some degree of association, between at least two females; otherwise the eggs would remain scattered over the wide plains, at distances far too great to allow of the male collecting them into one nest. Some have believed that the scattered eggs were deposited for the young birds to feed on. This can hardly be the case in America, because the huachos, although oftentimes found addled and putrid, are generally whole.

When at the Rio Negro, in Northern Patagonia, I repeatedly heard the Gauchos talking of a very rare bird which they called Avestruz Petise. They described it as being less than the common ostrich (which is there abundant), but with a very close general resemblance. They said its colour was dark and mottled, and that its legs were shorter, and feathered lower down than those of the common ostrich. It is more easily caught by the bolas than the other species. The few inhabitants who had seen both kinds, affirmed they could distinguish them apart from a long distance. The eggs of the small species appeared, however, more generally known; and it was remarked, with surprise, that they were very little less than those of the Rhea, but of a slightly different form, and with a tinge of pale blue. Some eggs, picked up on the plains of Patagonia, agree pretty well with this description, and I do not doubt are those of the Petise. This species occurs most rarely on the plains bordering the Rio Negro; but about a degree and a half further south they are tolerably abundant. One Gaucho, however, said he distinctly recollected having seen one, many years before, near the mouth of the Rio Colorado, which is to the north of the Rio Negro. They are said to prefer the plains near the sea. When at Port Desire, in Patagonia (lat. 48°), Mr. Martens shot an ostrich; and I looked at it, forgetting at the moment, in the most unaccountable manner, the whole subject of the Petises, and thought it was a two-third grown one of the common sort. The bird was cooked and eaten before my memory returned. Fortunately the head, neck, legs, wings, many of the larger feathers, and a large part of the skin, had

been preserved. From these a very nearly perfect specimen has been put together, and is now exhibited in the museum of the Zoological Society. Mr. Gould, who in describing this new species did me the honour of calling it after my name, states, that besides the smaller size and different colour of the plumage, the beak is of considerably less proportional dimensions than in the common Rhea; that the tarsi are covered with differently-shaped scales, and that they are feathered six inches beneath the knee. In this latter respect, and in the broader feathers of the wing, this bird perhaps shows more affinity to the gallinaceous family than any other of the Struthionidæ.

Among the Patagonian Indians in the Strait of Magellan, we found a half Indian, who had lived some years with the tribe, but had been born in the northern provinces. I asked him if he had ever heard of the Avestruz Petise? He answered by saying, "Why there are none others in these southern countries." He informed me that the number of eggs in the nest of the petise is considerably less than with the other kind, namely, not more than fifteen on an average; but he asserted that more than one female deposited them. At Santa Cruz we saw several of these birds. They were excessively wary: I think they could see a person approaching when he was so far off as not to distinguish the ostrich. In ascending the river few were seen; but in our quiet and rapid descent, many, in pairs and by fours or fives, were observed. It was remarked, and I think with truth, that this bird did not expand its wings, when first starting at full speed, after the manner of the northern kind. The fact of these ostriches swimming across the river has been mentioned. In conclusion, I may repeat that the *Struthio Rhea* inhabits the country of La Plata as far as a little south of the Rio Negro, in lat. 41°, and that the petise takes its place in Southern Patagonia; the part about the Rio Negro being neutral territory. Wallis saw ostriches at Batchelor's river (lat. 53° 54′), in the Strait of Magellan, which must be the extreme southern possible range of the petise. M. D'Or-

bigny, when at the Rio Negro, made great exertions to procure this bird, but never had the good fortune to succeed. He mentions it in his Travels,* and proposes (in case, I presume, of a specimen being obtained) to call it *Rhea pennata:* a fuller notice was given long before in Dobrizhoffer's Account of the Abipones† (A.D. 1749). He says, "You must know, moreover, that Emus differ in size and habits in different tracts of land; for those that inhabit the plains of Buenos Ayres and Tucuman are larger, and have black, white, and gray feathers; those near to the Strait of Magellan are smaller and more beautiful, for their white feathers are tipped with black at the extremity, and their black ones in like manner terminate in white."

A very singular little bird, lately described by St. Hilaire and Lesson under the name of *Tinochorus Eschscholtzii*, is here common. In its habits, general appearance, and structure, it nearly equally partakes of the character of a quail and a snipe. Yet these two birds are widely contrasted in the form of their beaks, wings, and legs. The Tinochorus is found in the whole of southern South America, wherever there are sterile plains, or open dry pasture-land. We saw it as far south as the inland plains of Patagonia at Santa Cruz, in lat. 50°. On the western side of the Cordillera near Concepcion, where the forest land changes into an open country, this bird is found: from that point throughout Chile, as far as Copiapó, it frequents the most desolate places, where scarcely another living creature can exist. They are found either in pairs or small flocks of five or six; but near the Sierra Ventana I saw as many as thirty or forty together. Upon being

* Vol. ii., p. 76.—When at the Rio Negro, we heard much of the indefatigable labours of this naturalist. M. D'Alcide D'Orbigny, during the years 1826 to 1833, traversed several large portions of South America, and has made a collection, and is now publishing the results on a scale of magnificence, which at once places him in the list of American travellers second only to Humboldt.

† Vol. i. (English translation), p. 314.

approached they squat close, and then are very difficult to be distinguished; so that they often rise quite unexpectedly. When feeding they walk rather slowly, with their legs wide apart. They dust themselves in roads and sandy places. They frequent particular spots, and may be found there day after day. When a pair are together, if one is shot the other seldom rises; for these birds, like partridges, only take wing in a flock. In all these respects, in the muscular gizzard adapted for vegetable food, in the arched beak and fleshy nostrils, short legs and form of foot, the Tinochorus has a close affinity with quails. But directly the bird is seen flying, one's opinion is changed; the long, pointed wings, so different from those in the gallinaceous order, the irregular manner of flight, and plaintive cry uttered at the moment of rising, recal the idea of a snipe. The sportsmen of the Beagle unanimously called it the shortbilled snipe. To this genus, or rather to that of the sandpiper, it approaches, as Mr. Gould informs me, in the shape of its wing, the length of the scapulars, the form of the tail, which closely resembles that of *Tringa hypoleucos*, and in the general colour of the plumage. The male bird, however, has a black mark on its breast, in the form of a yoke, which may be compared to the horseshoe on the breast of the English partridge. The nest is said to be placed on the borders of lakes, although the bird itself is an inhabitant of the parched desert.

The Tinochorus is closely related to some other South American birds. Two species of the genus Attagis, are in almost every respect ptarmigans in their habits; one in Tierra del Fuego, above the limits of forest land; the other just beneath the snow line on the Cordillera of Central Chile. A bird of another closely-allied genus, *Chionis alba*, which solitary species was long thought to form a family by itself, is an inhabitant of the antarctic regions; it feeds on sea-weed and shells on the tidal rocks. Although not web-footed, from some unaccountable taste it is frequently met with far out at sea. This small family of birds is one of

those which, from its varied relations, although at present offering only difficulties to the systematic naturalist, ultimately may assist in revealing the grand scheme, common to the present and past ages, on which organized beings have been created.

I may also briefly notice the genus Furnarius. It contains several species, all small birds, living on the ground, and inhabiting open, dry countries. In structure they cannot be compared to any European form. Ornithologists have generally included them among the creepers, although opposed to that family in every habit. The best known species is the common oven-bird of La Plata, the Casara or housemaker of the Spaniards, and *Furnarius rufus* of Viell. The nest, whence it takes its name, is placed in the most exposed situations, as on the top of a post, a bare rock, or on a cactus. It is composed of mud and bits of straw, and has strong thick walls: in shape it precisely resembles an oven, or depressed beehive. The opening is large and arched, and directly in front, within the nest, there is a partition, which reaches nearly to the roof, thus forming a passage or antechamber to the true nest.

Another and smaller species of Furnarius, something like a lark in appearance, resembles the oven-bird in many points, as in the general reddish tint of its plumage, a peculiar shrill reiterated cry, an odd manner of running by starts, &c. From its affinity, the Spaniards call it Casarita (or little housebuilder), although its nidification is quite different. The Casarita builds its nest at the bottom of a narrow cylindrical hole, which is said to extend horizontally to nearly six feet under ground. Several of the country people told me, that when boys they had attempted to dig out the nest, but had scarcely ever succeeded in getting to the end. The bird chooses any low bank of firm sandy soil by the side of a road or stream. Here (at Bahia Blanca) the walls are built of hardened mud; and I noticed that one, which enclosed a courtyard where I lodged, was penetrated by round holes in a score of places. On asking the owner

the cause of this, he bitterly complained of the little casarita, several of which I afterwards observed at work. It is rather curious, that although they were constantly flitting over the low wall, they must be quite incapable of gaining an idea of thickness even after the shortest circuitous route, for otherwise they would not have made so many vain attempts. I do not doubt that each bird, as often as it came to daylight on the opposite side, was greatly surprised at the marvellous fact.

I have already mentioned nearly all the mammalia common in this country. Of armadilloes three species occur, namely, the Dasypus minutus or *pichy*, the Villosus or *peludo*, and the *apar*. The first extends as far south as lat. 50°, which is about ten degrees further than any other kind. A fourth species, the *Mulita*, only extends as far south as the Sierra Tapalguen, lat. 37° 30′, which is north of Bahia Blanca. The four species have nearly similar habits; the *peludo*, however, is nocturnal, while the others wander by day over the open plains, feeding on beetles, larvæ, roots, and even small snakes. The *apar*, commonly called *mataco*, is remarkable by having only three moveable bands; the rest of its tesselated covering being nearly inflexible. It has the power of rolling itself into a perfect sphere, like one kind of English woodlouse. In this state it is safe from the attack of dogs; for the dog not being able to take the whole in its mouth, tries to bite one side, and the ball slips away. The smooth hard covering of the *mataco* offers a better defence than the sharp spines of the hedgehog. The *pichy* prefers a very dry soil, and the sand-dunes near the coast, where for many months it can never taste water, is its favourite resort. In the course of a day's ride, near Bahia Blanca, several were generally met with. The instant one was perceived, it was necessary in order to catch it, almost to tumble off one's horse; for if the soil was soft, the animal burrowed so quickly, that its hinder quarters had almost disappeared before one could alight. The *pichy* likewise often tries to escape notice, by squatting close to the ground. It appears almost

a pity to kill such nice little animals, for as a Gaucho said, while sharpening his knife on the back of one, "Son tan mansos" (they are so quiet).

Of reptiles there are many kinds: one snake (a Trigonocephalus, or more properly a Cophias), from the size of the poison channel in its fangs, must be very deadly. Cuvier, in opposition to some other naturalists, makes this a sub-genus of the rattlesnake, and intermediate between it and the viper. In confirmation of this opinion, I observed a fact, which appears to me very curious and instructive, as showing how every character, even though it may be in some degree independent of structure, has a tendency to vary by slow degrees. The extremity of the tail of this snake is terminated by a point, which is very slightly enlarged; and as the animal glided along, it constantly vibrated the last inch; and this part striking against the dry grass and brushwood, produced a rattling noise, which could be distinctly heard at the distance of six feet. As often as the animal was irritated or surprised, its tail was shaken; and the vibrations were extremely rapid. Even as long as the body retained its irritability, a tendency to this habitual movement was evident. This Trigonocephalus has, therefore, in some respects the structure of Vipera, with the habits of a Crotalus; the noise, however, being produced by a simpler device. The expression of this snake's face was hideous and fierce; the pupil consisted of a vertical slit in a mottled and coppery iris; the jaws were broad at the base, and the nose terminated in a triangular projection. I do not think I ever saw any thing more ugly, excepting, perhaps, in some of the vampire bats. I imagine this repulsive aspect originates from the features being placed in positions, with respect to each other, somewhat proportional to those of the human face; and thus we obtain a scale of beauty.

Amongst the Batrachian reptiles, I found only one little toad, which was most singular from its colour. If we imagine, first, that it had been steeped in the blackest ink, and then when dry, allowed to crawl over a board, freshly painted

with the brightest vermilion, so as to colour the soles of its feet and parts of its stomach, a good idea of its appearance will be gained. If it is an unnamed species, surely it ought to be called *diabolicus*, for it is a fit toad to preach in the ear of Eve. Instead of being nocturnal in its habits, as other toads are, and living in damp obscure recesses, it crawls during the heat of the day about the dry sand-hillocks and arid plains, where not a single drop of water can be found. It must necessarily depend on the dew for its moisture; and this probably is absorbed by the skin, for it is known, that these reptiles possess great powers of cutaneous absorption. At Maldonado, I found one in a situation nearly as dry as at Bahia Blanca, and thinking to give it a great treat, carried it to a pool of water; not only was the little animal unable to swim, but, I think, without help would soon have been drowned.

Of lizards there were many kinds, but only one remarkable, from its habits. It lives on the bare sand near the sea coast, and from its mottled colour, the brownish scales being speckled with white, yellowish red, and dirty blue, can hardly be distinguished from the surrounding surface. When frightened it attempts to avoid discovery by feigning death, with outstretched legs, depressed body, and closed eyes: if further molested, it buries itself with great quickness in the loose sand. This lizard, from its flattened body and short legs, cannot run quickly. It belongs to the genus Ophryessa.

I will here add a few remarks on the hybernation of animals in this part of South America. When we first arrived at Bahia Blanca, September 7th, 1832, we thought nature had granted scarcely a living creature to this sandy and dry country. By digging, however, in the ground, several insects, large spiders, and lizards were found in a half torpid state. On the 15th, a few animals began to appear, and by the 18th (three days from the equinox), every thing announced the commencement of spring. The plains were ornamented by the flowers of a pink wood sorrel, wild peas, œnotheræ, and geraniums; and the birds began to lay their

eggs. Numerous Lamellicorn and Heteromerous insects, the latter remarkable for their deeply sculptured bodies, were slowly crawling about; while the Saurian tribe, the constant inhabitants of a sandy soil, darted in every direction. During the first eleven days, whilst nature was dormant, the mean temperature taken from observations made every two hours on board the Beagle, was 51°; and in the middle of the day the thermometer seldom ranged above 55°. On the eleven succeeding days, in which all living things became so animated, the mean was 58°, and the range in the middle of the day between sixty and seventy. Here then an increase of seven degrees in mean temperature, but a greater one of extreme heat, was sufficient to awake the functions of life. At Monte Video, from which we had just before sailed, in the twenty-three days included between the 26th of July and the 19th of August, the mean temperature from 276 observations was 58°.4; the mean hottest day being 65°.5, and the coldest 46°. The lowest point to which the thermometer fell was 41°.5, and occasionally in the middle of the day it rose to 69° or 70°. Yet with this elevated temperature, almost every beetle, several genera of spiders, snails, and land shells, toads, and lizards were all lying torpid beneath stones. But we have seen that at Bahia Blanca, which is four degrees to the southward, and therefore with a climate only a very little colder, this same temperature with a rather less extreme heat, was sufficient to awake all orders of animated beings. This shows how nicely the required degree of stimulus is adapted to the general climate of the place, and how little it depends on absolute temperature. It is well known that within the tropics, the hybernation, or more properly estivation, of animals is governed by the times of drought. Near Rio de Janeiro, I was at first surprised to observe, that, a few days after some little depressions had been changed into pools of water by the rain, they were peopled by numerous full-grown shells and beetles. Humboldt has related the strange accident of a hovel having been erected over a spot, where a young crocodile lay buried in

the hardened mud. He adds "The Indians often find enormous boas; which they call Uji, or water serpents, in the same lethargic state. To reanimate them, they must be irritated or wetted with water."

I will only mention one other animal, a zoophyte allied to Virgularia,* a kind of sea-pen. It consists of a thin, straight, fleshy stem, with alternate rows of polypi on each side, and surrounding an elastic stony axis. It varies in length from eight inches to two feet. The stem at one extremity is truncate, but at the other is terminated by a vermiform fleshy appendage, which is separated into two compartments; and in these, small, yellow, spherical ova are contained. The stony axis which gives strength to the stem, may be traced at this extremity into a mere vessel filled with granular matter. This undeveloped portion is enclosed in a transparent, elastic, irritable bag, containing a fluid in which a very distinct circulation of particles could be seen. This bag floats in one of the compartments of the fleshy terminal appendage. At low water hundreds of these zoophytes might be seen, projecting like stubble, with the truncate end upwards, a few inches above the surface of the muddy sand. When touched or pulled, they drew themselves in, suddenly and with force, so as nearly or quite to disappear. By this action, the highly elastic axis must be bent at the lower extremity, where it is naturally slightly curved; and I imagine it is by this elasticity that the zoophyte is enabled to rise again through the mud. Each polypus, though closely united to its brethren, has a distinct mouth, body, and tentacula. Of these polypi, in a large specimen, there must be many thousands; yet we see that they act by one movement; that they have one central axis connected with a system of obscure circulation; and that the ova are produced in an organ distinct from the separate individuals. Well may one be allowed to ask, what is an individual? I will add only one other observation on this zoophyte. The cavities leading from the fleshy compartments of the extremity, were filled

* I believe *Virgularia Patagonica* of D'Orbigny.

with a yellow pulpy matter, which, examined under a microscope, presented an extraordinary appearance. The mass consisted of rounded, semi-transparent, irregular grains, aggregated together into particles of various sizes. All such particles, and the separate grains, possessed the power of rapid movement; generally revolving around different axes, but sometimes progressive. The movement was visible with a very weak power, but with the highest its cause could not be perceived. It was very different from the circulation of the fluid in the elastic bag, containing the thin extremity of the axis. On other occasions, when dissecting small marine animals beneath the microscope, I have seen particles of pulpy matter, some of large size, immediately they were disengaged, commence revolving. I have imagined, I know not with how much truth, that this granulo-pulpy matter was in process of being converted into ova. Certainly in this zoophyte such appeared to be the case.

During my stay at Bahia Blanca, while waiting for the Beagle, the place was in a constant state of excitement, from rumours of wars and victories, between the troops of Rosas and the wild Indians. One day an account came, that a small party forming one of the postas on the line to Buenos Ayres, had been found all murdered. The next day, three hundred men arrived from the Colorado, under the command of Commandant Miranda. A large portion of these men were Indians (*mansos*, or tame), belonging to the tribe of the Cacique Bernantio. They passed the night here; and it was impossible to conceive any thing more wild and savage than the scene of their bivouac. Some drank till they were intoxicated; others swallowed the steaming blood of the cattle slaughtered for their suppers, and then, being sick from drunkenness, they cast it up again, and were besmeared with filth and gore.

> Nam simul expletus dapibus, vinoque sepultus
> Cervicem inflexam posuit, jacuitque per antrum
> Immensus, saniem eructans, ac frusta cruenta
> Per somnum commixta mero.

In the morning they started for the scene of the murder, with orders to follow the "rastro," or track, even if it led them to Chile. We subsequently heard that the wild Indians had escaped into the great Pampas, and from some cause the track had been missed. One glance at the rastro tells these people a whole history. Supposing they examine the track of a thousand horses, they will soon guess by seeing how many have cantered the number of men; by the depth of the other impressions, whether any horses were loaded with cargoes; by the irregularity of the footsteps, how far tired; by the manner in which the food has been cooked, whether the pursued travelled in haste; by the general appearance, how long it has been since they passed. They consider a rastro of ten days or a fortnight, quite recent enough to be hunted out. We also heard that Miranda struck from the west end of the Sierra Ventana, in a direct line to the island of Cholechel, situated seventy leagues up the Rio Negro. This is a distance of between two and three hundred miles, through a country completely unknown. What other troops in the world are so independent? With the sun for their guide, mares' flesh for food, their saddle-cloths for beds,—as long as there is a little water, these men would penetrate to the land's end.

A few days afterwards I saw another troop of these banditti-like soldiers start on an expedition against a tribe of Indians at the small salinas, who had been betrayed by a prisoner cacique. The Spaniard who brought the orders for this expedition was a very intelligent man. He gave me an account of the last engagement at which he was present. Some Indians, who had been taken prisoners, gave information of a tribe living north of the Colorado. Two hundred soldiers were sent; and they first discovered the Indians by a cloud of dust from their horses' feet, as they chanced to be travelling. The country was mountainous and wild, and it must have been far in the interior, for the Cordillera was in sight. The Indians, men, women, and children, were about one hundred and ten in number, and they were nearly all

taken or killed, for the soldiers sabre every man. The Indians are now so terrified, that they offer no resistance in a body, but each flies, neglecting even his wife and children; but when overtaken, like wild animals, they fight against any number to the last moment. One dying Indian seized with his teeth the thumb of his adversary, and allowed his own eye to be forced out, sooner than relinquish his hold. Another, who was wounded, feigned death, keeping a knife ready to strike one more fatal blow. My informer said, when he was pursuing an Indian, the man cried out for mercy, at the same time that he was covertly loosing the bolas from his waist, meaning to whirl it round his head and so strike his pursuer. "I however struck him with my sabre to the ground, and then got off my horse, and cut his throat with my knife." This is a dark picture; but how much more shocking is the unquestionable fact, that all the women who appear above twenty years old, are massacred in cold blood. When I exclaimed that this appeared rather inhuman, he answered, "Why, what can be done? they breed so!"

Every one here is fully convinced that this is the most just war because it is against barbarians. Who would believe in this age, in a Christian civilized country, that such atrocities were committed? The children of the Indians are saved, to be sold or given away as servants, or rather slaves, for as long a time as the owners can deceive them; but I believe in this respect there is little to complain of.

In the battle four men ran away together. They were pursued, and one was killed, but the other three were taken alive. They turned out to be messengers or ambassadors from a large body of Indians, united in the common cause of defence, near the Cordillera. The tribe to which they had been sent was on the point of holding a grand council; the feast of mare's flesh was ready, and the dance prepared: in the morning the ambassadors were to have returned to the Cordillera. They were remarkably fine men, very fair, above six feet high, and all under thirty years of age. The three survivors of course possessed very valuable information; and

to extort this they were placed in a line. The two first being questioned, answered, "No se" (I do not know), and were one after the other shot. The third also said "No se;" adding, "Fire, I am a man, and can die!" Not one syllable would they breathe to injure the united cause of their country! The conduct of the cacique was very different: he saved his life by betraying the intended plan of warfare, and the point of union in the Andes. It was believed that there were already six or seven hundred Indians together, and that in summer their numbers would be doubled. Ambassadors were to have been sent to the Indians at the small salinas, near Bahia Blanca, whom I mentioned that a cacique, this same man, had betrayed. The communication, therefore, extends from the Cordillera to the east coast.

General Rosas's plan is to kill all stragglers, and having driven the remainder to a common point, in the summer, with the assistance of the Chilenos, to attack them in a body. This operation is to be repeated for three successive years. I imagine the summer is chosen as the time for the main attack, because the plains are then without water, and the Indians can only travel in particular directions. The escape of the Indians to the south of the Rio Negro, where in such a vast unknown country they would be safe, is prevented by a treaty with the Tehuelches to this effect;—that Rosas pays them so much to slaughter every Indian who passes to the south of the river, but if they fail in so doing, they themselves are to be exterminated. The war is waged chiefly against the Indians near the Cordillera; for many of the tribes on this eastern side are fighting with Rosas. The general, however, like Lord Chesterfield, thinking that his friends may in a future day become his enemies, always places them in the front ranks, so that their numbers may be thinned. Since leaving South America we have heard that this war of extermination completely failed.

Among the captive girls taken in the same engagement, there were two very pretty Spanish ones, who had been car-

ried away by the Indians when young, and could now only speak the Indian tongue. From their account, they must have come from Salta, a distance in a straight line of nearly one thousand miles. This gives one a grand idea of the immense territory over which the Indians roam: yet, great as it is, I think there will not, in another half-century, be a wild Indian northward of the Rio Negro. The warfare is too bloody to last; the Christians killing every Indian, and the Indians doing the same by the Christians. It is melancholy to trace how the Indians have given way before the Spanish invaders. Schirdel* says, that in 1535, when Buenos Ayres was founded, there were villages containing two and three thousand inhabitants. Even in Falconer's time (1750) the Indians made inroads as far as Lucan, Areco, and Arrecife, but now they are driven beyond the Salado. Not only have whole tribes been wholly exterminated, but the remaining Indians have become more barbarous: instead of living in large villages, and being employed in the arts of fishing, as well as of the chase, they now wander about the open plains, without home or fixed occupation.

I heard also some account of an engagement which took place, a few weeks previously to the one mentioned, at Cholechel. This is a very important station, on account of being a pass for horses; and it was, in consequence, for some time the head-quarters of a division of the army. When the troops first arrived there, they found a tribe of Indians, of whom they killed twenty or thirty. The cacique escaped in a manner which astonished every one. The chief Indians always have one or two picked horses, which they keep ready for any urgent occasion. On one of these, an old white horse, the cacique sprung, taking with him his little son. The horse had neither saddle nor bridle. To avoid the shots, the Indian rode in the peculiar method of his nation; namely, with an arm round the horse's neck, and one leg only on its back. Thus hanging on one side, he was

* Purchas's Collection of Voyages.

seen patting the horse's head, and talking to him. The pursuers urged every effort in the chase; the Commandant three times changed his horse, but all in vain. The old Indian father and his son escaped, and were free. What a fine picture one can form in one's mind,—the naked bronze-like figure of the old man with his little boy, riding like a Mazeppa on the white horse, thus leaving far behind him the host of his pursuers!

I saw one day a soldier striking fire with a piece of flint, which I immediately recognised as having been a part of the head of an arrow. He told me it was found near the island of Cholechel, and that they are frequently picked up there. It was between two and three inches long, and therefore twice as large as those now used in Tierra del Fuego: it was made of opake cream-coloured flint, but the point and barbs had been intentionally broken off. It is well known that no Pampas Indians now use bows and arrows. I believe a small tribe in Banda Oriental must be excepted; but they are widely separated from the Pampas Indians, and border close on those tribes that inhabit the forest, and live on foot. It appears, therefore, that these arrow-heads are antiquarian* relics of the Indians, before the great change in habits consequent on the introduction of the horse into South America.

* Azara has even doubted whether the Pampas Indians ever used bows.

CHAPTER VI.

Set out for Buenos Ayres—Rio Sauce—Sierra Ventana—Transportal of pebbles—Third posta—Driving horses—Bolas—Partridges and foxes—Features of country—Long-legged plover—Teru-tero—Hailstorm—Natural enclosures in Sierra Tapalguen—Flesh of puma—Meat diet—Guardia del Monte—Effects of cattle on the vegetation—Cardoon—Buenos Ayres—Corral where animals are slaughtered.

BAHIA BLANCA TO BUENOS AYRES.

SEPTEMBER 8TH.—Having with some difficulty hired a Gaucho to accompany me, on my ride to Buenos Ayres, we started early in the morning. The distance is about four hundred miles, and nearly the whole way through an uninhabited country. Ascending a few hundred feet from the basin of green turf on which Bahia Blanca stands, we entered on a wide desolate plain. It consists of a crumbling argillaceo-calcareous rock, which, from the dry nature of the climate, supports only scattered tufts of withered grass, without a single bush or tree to break the monotonous uniformity. The weather was fine, but the atmosphere remarkably hazy; I thought the appearance foreboded a gale, but the Gauchos said it was owing to the plain, at some great distance in the interior, being on fire. After a long gallop, having changed horses twice, we reached the Rio Sauce. It is a deep, rapid, little stream, but not above twenty-five feet wide. The second posta on the road to Buenos Ayres stands on its banks; a little above there is a pass for horses, where the water does not reach to the horse's belly; but from that point, in its course to the sea, it is quite impassable, and hence makes a most useful barrier against the Indians.

Insignificant as this stream is, the Jesuit Falconer, whose information is generally so very correct, figures it as a considerable river, rising at the foot of the Cordillera. With respect to its source, I do not doubt this is the case; for the

Gauchos assured me, that in the middle of the dry summer, this stream, at the same time with the Colorado, has periodical floods; which can only originate in the snow melting on the Andes. It is extremely improbable that a stream, so small as the Sauce then was, should traverse the entire width of the continent; and indeed, if it were the residue of a large river, its waters, as in other ascertained cases, would be saline. During the winter we must look to the springs round the Sierra Ventana as the source of its pure and limpid stream. I suspect the plains of Patagonia, like those of Australia, are traversed by many water-courses, which only perform their proper parts at certain periods. Probably this is the case with the water which flows into the head of Port Desire, and likewise with the Rio Chupat, on the banks of which masses of highly cellular scoriæ were found by the officers employed in the survey.

As it was early in the afternoon when we arrived, we took fresh horses, and a soldier for a guide, and started for the Sierra de la Ventana. This mountain is visible from the anchorage at Bahia Blanca; and Capt. FitzRoy calculates its height to be 3500 feet;—an altitude very remarkable on this eastern side of the continent. I am not aware that any foreigner, previous to my visit, had ascended this mountain; and indeed very few of the soldiers at Bahia Blanca knew any thing about it. Hence we heard of beds of coal, of gold and silver, of caves, and of forests, all of which inflamed my curiosity, only to disappoint it. The distance from the posta was about six leagues, over a level plain of the same character as before. The ride was, however, interesting, as the mountain began to show its true form. When we reached the foot of the main ridge, we had much difficulty in finding any water, and we thought we should have been obliged to have passed the night without any. At last we discovered some, by looking close to the mountain, for at the distance even of a few hundred yards, the streamlets were buried and entirely lost in the friable calcareous stone, and loose detritus. I do not think nature ever made a more solitary,

desolate pile of rock;—it well deserves its name of *Hurtado*, or separated. The mountain is steep, extremely rugged, and broken, and so entirely destitute of trees and even bushes, that we actually could not find a skewer to stretch out our meat over the fire made of thistle* stalks. The strange aspect of this mountain is contrasted by the sea-like plain, which not only abuts against its steep sides, but likewise separates the parallel ranges. The uniformity of the colouring gives, also, an extreme quietness to the view;—the whitish gray of the quartz rock, and the light brown of the withered grass of the plain, being unrelieved by any brighter tint. From custom, one expects to see in the neighbourhood of a lofty and bold mountain a broken country, strewed over with huge fragments. Here nature shows, that the last movement before the bed of the sea is changed into dry land, may sometimes be one of tranquillity. Under these circumstances, I was curious to observe how far from the parent rock any pebbles could be found. On the shores of Bahia Blanca, and near the settlement, there were some of quartz, which certainly must have come from this source: the distance is forty-five miles.

The dew, which in the early part of the night wetted the saddle-cloths, under which we slept, was in the morning frozen. From the sharpness of the cold, I supposed we were already at a considerable elevation, although, to the eye, the plain had appeared horizontal. In the morning (9th September) the guide told me to ascend the nearest ridge, which he thought would lead me to the four peaks that crown the summit. The climbing up such rough rocks was very fatiguing, the sides were so indented, that, what was gained in one five minutes, was often lost in the next. At last, when I reached the ridge, my disappointment was extreme in finding a precipitous valley as deep as the plain, which cut the chain transversely in two, and separated me from the four

* I call these thistle stalks for the want of a more correct name. I believe it is a species of Eryngium.

points. This valley is very narrow, but flatbottomed, and it forms a fine horse-pass for the Indians, as it connects the plains on the northern and southern sides of the range. Having descended, and while crossing it, I saw two horses grazing: I immediately hid myself in the long grass, and began to reconnoitre; but as I could see no signs of Indians, I proceeded cautiously on my second ascent. It was late in the day, and this part of the mountain, like the other, was steep and rugged. I was on the top of the second peak by two o'clock, but got there with extreme difficulty; every twenty yards I had the cramp in the upper part of both thighs, so that I was afraid I should not have been able to have descended. It was also necessary to return by another road, as it was out of the question to pass over the saddle-back. I was therefore obliged to give up the two higher peaks. Their altitude was but little greater, and every purpose of geology had been answered; so that the attempt was not worth the hazard of any further exertion. I presume the cause of the cramp was the great change in the kind of muscular action, from that of hard riding to that of still harder climbing. It is a lesson worth remembering, as in some cases it might cause much difficulty.

I have already said the mountain is composed of white quartz rock, and with it a little glossy clay-slate is associated. At the height of a few hundred feet above the plain, patches of conglomerate adhered in several places to the solid rock. They resembled in hardness, and in the nature of the cement, the masses which may be seen daily forming on some coasts. I do not doubt these pebbles were, in a similar manner, aggregated, at a period when the great calcareous formation was depositing beneath the surrounding sea. We may believe that the jagged and battered forms of the hard quartz yet show the effects of the waves of an open ocean.

I was, on the whole, disappointed with this ascent. Even the view was insignificant;—a plain like the sea, but without its beautiful colour and defined outline. The scene, however, was novel, and a little danger, like salt to meat, gives it

a relish. That the danger was very little was certain, for my two companions made a good fire—a thing which is never done when it is suspected that Indians are near. I reached the place of our bivouac by sunset, and drinking much maté, and smoking several cigaritos, soon made up my bed for the night. The wind was very strong and cold, but I never slept more comfortably.

September 10th.—In the morning, having fairly scudded before the gale, we arrived by the middle of the day at the Sauce posta. On the road we saw great numbers of deer, and near the mountain a guanaco. The plain, that abuts against the Sierra, is traversed by some curious gullies, of which one was about twenty feet wide, and at least thirty deep; we were obliged in consequence to make a considerable circuit, before we could find a pass. We staid the night at the posta, the conversation, as was generally the case, being about the Indians. The Sierra Ventana was formerly a great place of resort; and three or four years ago there was much fighting here. My guide had been present when many men were killed: the women escaped to the top of the ridge, and fought most desperately with big stones; many thus saving themselves.

September 11th.—Proceeded to the third posta in company with the lieutenant who commanded it. The distance is called fifteen leagues; but it is only guess-work and is generally overstated. The road was uninteresting, over a dry grassy plain; and on our left hand at a greater or less distance there were some low hills; a chain of which, we crossed close to the posta. Before our arrival, we met a large herd of cattle and horses, guarded by fifteen soldiers; but we were told many had been lost. It is very difficult to drive animals across the plains; for if in the night a lion, or even a fox, approaches, nothing can prevent the horses dispersing in every direction; and a storm will have the same effect. A short time since, an officer left Buenos Ayres with 500 horses, and when he arrived at the army he had under twenty.

Soon afterwards we perceived by the cloud of dust, that a

party of horsemen were coming towards us; when far distant my companions knew them to be Indians, by their long hair streaming behind their backs. The Indians generally have a fillet round their heads, but never any covering; and their black hair blowing across their swarthy faces, heightens to an uncommon degree, the wildness of their appearance. They turned out to be a party of Bernantio's friendly tribe, going to a salina for salt. The Indians eat much salt, their children sucking it like sugar. This habit is very different from that of the Spanish Gauchos, who, leading the same kind of life, eat scarcely any. The Indians gave us good-humoured nods as they passed at full gallop, driving before them a troop of horses, and followed by a train of lanky dogs.

September 12th and 13th.—I staid at this posta two days, waiting for a troop of soldiers, which, General Rosas had the kindness to send to inform me, would shortly travel to Buenos Ayres; and he advised me to take the opportunity of such an escort. In the morning we rode to some neighbouring hills to view the country, and to examine the geology. After dinner the soldiers divided themselves into two parties for a trial of skill with the bolas. Two spears were stuck in the ground thirty-five yards apart, but they were struck and entangled only once in four or five times. The balls can be thrown fifty or sixty yards, but with little certainty. This, however, does not apply to a man on horseback; for when the speed of the horse is added to the force of the arm, it is said, that they can be whirled with effect to the distance of eighty yards.* In the middle of the day two men had ar-

* As a proof of the force with which the balls are hurled, I may mention an anecdote that happened at the Falkland Islands. At the time the Spaniards murdered some of their own countrymen, and all the Englishmen, a young Spaniard was running away, when a great tall Indian, by name Luciano, came at full gallop after him, shouting to him to stop, and saying that he only wanted to speak to him. Just as the Spaniard was on the point of reaching the boat, Luciano threw the balls: they struck him on the legs, with such a jerk, as to throw him down and to render him for some time insensible. The man, after Luciano had had his talk, was al-

rived, who brought a parcel from the next posta to be forwarded to the general; so that besides these two, our party consisted of myself and guide, the lieutenant and his four soldiers. The latter were strange beings; the first a fine young negro; the second half Indian and negro; and the two others nondescripts; namely, an old Chilian miner, the colour of mahogany, and another partly a mulatto; but two such mongrels, with such detestable expressions, I never saw before. At night, when they were sitting round the fire, and playing at cards, I retired to view such a Salvator Rosa scene. They were seated under a low cliff, so that I could look down upon them; around the party were lying dogs, arms, remnants of deer and ostriches; and their long spears were stuck in the turf. Further in the dark background, their horses were tied up, ready for any sudden danger. If the stillness of the desolate plain was broken by one of the dogs barking, a soldier, leaving the fire, would place his head close to the ground, and thus slowly scan the horizon. Even if the noisy teru-tero uttered its scream, there would be a pause in the conversation, and every head, for a moment a little inclined.

What a life of misery these men appear to us to lead! They were at least ten leagues from the Sauce posta, and since the murder committed by the Indians, twenty from another. The Indians are supposed to have made their attack in the middle of the night; for very early in the morning after the murder, they were luckily seen approaching this posta. The whole party, however, escaped, together with the troop of horses; each one taking a line for himself, and driving with him as many animals as he was able to manage.

The little hovel, built of thistle-stalks, in which they slept, neither kept out the wind or rain; indeed in the latter case the only effect the roof had, was to condense it into larger

lowed to escape. He told us that his legs were marked by great weals, where the thong had wound round, as if he had been flogged with a whip.

drops. They had nothing to eat excepting what they could catch, such as ostriches, deer, armadilloes, &c., and their only fuel was the dry stalks of a small plant, somewhat resembling an aloe. The sole luxury which these men enjoyed was smoking the little paper cigars, and sucking maté. I used to think the carrion vulture, man's constant attendant on these dreary plains, while seated on some little eminence, seemed by its very patience to say, "Ah! when the Indians come we shall have a feast."

In the morning we all sallied forth to hunt, and although we had not much success, there were some animated chases. Soon after starting the party separated, and so arranged their plans, that at a certain time of the day (in guessing which they show much skill) they should all meet from different points of the compass on a plain piece of ground, and thus drive together the wild animals. One day I went out hunting at Bahia Blanca, but the men there merely rode in a crescent, each being about a quarter of a mile apart from the other. A fine male ostrich being turned by the headmost riders, tried to escape on one side. The Gauchos pursued at a reckless pace, twisting their horses about with the most admirable command, and each man whirling the balls round his head. At length the foremost threw them, revolving through the air: in an instant the ostrich rolled over and over, its legs fairly lashed together by the thong.

The plains abound with three kinds of partridge,* two of which are as large as hen pheasants. Their destroyer, a small and pretty fox, was also singularly numerous; in the course of the day we could not have seen less than forty or fifty. They were generally near their earths, but the dogs killed one. When we returned to the posta, we found two of the party returned who had been hunting by themselves. They had killed a puma, and had found an ostrich's nest with twenty-seven eggs in it. Each of these is said to equal in

* Two species of Tinamus, and *Eudromia elegans* of D'Orbigny, which can only be called a partridge with regard to its habits.

weight eleven hens' eggs; so that we obtained from this one nest as much food as 297 hens' eggs would have yielded.

SEPTEMBER 14TH.—As the soldiers belonging to the next posta meant to return, and we should together make a party of five, and all armed, I determined not to wait* for the expected troops. After galloping some leagues, we came to a low swampy country, which extends for nearly eighty miles to the northward, as far as the Sierra Tapalguen. In some parts there were fine damp plains, covered with grass, while others had a soft, black, and peaty soil. There were also many extensive but shallow lakes, and large beds of reeds. The country on the whole resembled the better parts of the Cambridgeshire fens. At night we had some difficulty in finding, amidst the swamps, a dry place for our bivouac.

SEPTEMBER 15TH.—Rose very early in the morning, and shortly after passed the posta, where the Indians had murdered the five soldiers. The officer had eighteen chuzo wounds in his body. By the middle of the day, after a hard gallop, we reached the fifth posta: on account of some difficulty in procuring horses we staid there the night. As this point was the most exposed on the whole line, twenty-one soldiers were stationed there; at sunset they returned from hunting, bringing with them seven deer, three ostriches, and many armadilloes and partridges. When riding through the country, it is a common practice to set fire to the plain; and hence at night, as on this occasion, the horizon was illuminated in several places by brilliant conflagrations. This is done partly for the sake of puzzling any stray

* The lieutenant pressed me much to stop. As he had been very obliging—not only providing me with food, but lending me his private horses—I wanted to make him some remuneration. I asked my guide whether I might do so, but he told me certainly not; that the only answer I should receive, probably would be, "We have meat for the dogs in our country, and therefore do not grudge it to a Christian." It must not be supposed that the rank of lieutenant in such an army, would at all prevent the acceptance of payment: it was only the high sense of hospitality, which every traveller is bound to acknowledge as nearly universal throughout these provinces.

Indians, but chiefly for improving the pasture. In grassy plains unoccupied by the larger ruminating quadrupeds, it seems necessary to remove by fire the superfluous vegetation, so as to render serviceable the new year's growth.

The rancho at this place did not boast even of a roof, but merely consisted of a ring of thistle-stalks, to break the force of the wind. It was situated on the borders of an extensive but shallow lake, swarming with wild fowl, among which the black-necked swan was conspicuous.

The kind of plover, which appears is if mounted on stilts, (*Himantopus melanura*) is here common in flocks of considerable size. It has been wrongfully accused of inelegance; when wading about in shallow water, which is its favourite resort, its gait is far from awkward. These birds in a flock utter a noise, that singularly resembles the cry of a pack of small dogs in full chase: waking in the night, I have more than once been for a moment startled at the distant sound. The teru-tero (*Vanellus cayanensis*), is another bird, which often disturbs the stillness of the night. In appearance and habits it resembles in many respects our peewits; its wings, however, are armed with sharp spurs, like those on the legs of the common cock. As our peewit takes its name from the sound of its voice, so does the teru-tero. While riding over the grassy plains, one is constantly pursued by these birds, which appear to hate mankind, and I am sure deserve to be hated, for their never-ceasing, unvaried, harsh screams. To the sportsman they are most annoying, by telling every other bird and animal of his approach: to the traveller in the country, they may possibly, as Molina says, do good, by warning him of the midnight robber. During the breeding season, they attempt, like our peewits, by feigning to be wounded, to draw away from their nests dogs and other enemies. The eggs of this bird are esteemed a great delicacy.

September 16th.—To the seventh posta at the foot of the Sierra Tapalguen. The country was quite level, with a coarse herbage and a soft peaty soil. The hovel was there remarkably neat, the posts and rafters being made of about a

dozen dry thistle-stalks bound together with thongs of hide; and by the aid of these Ionic-like columns the roof and sides were thatched with reeds. We were here told a fact, which I would not have credited, if I had not had partly ocular proof of it; namely, that, during the previous night, hail as large as small apples, and extremely hard, had fallen with such violence, as to kill the greater number of the wild animals. One of the men had already found thirteen deer (*Cervus campestris*) lying dead, and I saw their *fresh* hides; another of the party, a few minutes after my arrival, brought in seven more. Now I well know, that one man without dogs, would hardly have killed seven deer in a week. The men believed they had seen about fifteen dead ostriches (part of one of which we had for dinner); and they said that several were running about evidently blind in one eye. Numbers of smaller birds, as ducks, hawks, and partridges, were killed. I saw one of the latter with a black mark on its back, as if it had been struck with a paving-stone. A fence of thistle-stalks round the hovel, was nearly broken down, and my informer putting his head out to see what was the matter, received a severe cut, and now wore a bandage. The storm was said to have been of limited extent: we certainly saw from our last night's bivouac a dense cloud and lightning in this direction. It is marvellous how such strong animals as deer could thus have been killed; but I have no doubt, from the evidence I have given, that the story is not in the least exaggerated. I am glad, however, to have its credibility supported by the Jesuit Drobrizhoffer,* who, speaking of a country much to the northward, says, hail fell of an enormous size and killed vast numbers of cattle: the Indians hence called the place *Lalegraicavalca*, meaning "The little white things."

Having finished our dinner of hail-stricken meat, we crossed the Sierra Tapalguen; a low range of hills, a few hundred feet in height, which commences at Cape Corrientes.

* History of the Abipones, vol. ii., p. 6.

The rock in this part is pure quartz; further eastward I understand it is granitic. The hills are of a remarkable form; they consist of flat patches of table-land, surrounded by low but perpendicular cliffs, like the outliers of a sedimentary deposit. The hill which I ascended was very small, not above a couple of hundred yards in diameter; but I saw others larger. One which goes by the name of the "Corral," is said to be two or three miles in diameter, and encompassed on all sides by perpendicular cliffs, between thirty and forty feet high, excepting at one spot, where the entrance lies. Falconer* gives a curious account of the Indians driving within it troops of wild horses, and then by guarding the entrance, keeping them secure. I have never heard of any other instance of table-land in a formation of quartz, and which, in the hill I examined, had neither cleavage or stratification. I was told that the rock of the "Corral" was white, and would strike fire.

We did not reach the posta on the Rio Tapalguen till after it was dark. At supper, from something which was said, I was suddenly struck with horror at thinking that I was eating one of the favourite dishes of the country, namely, a half-formed calf, long before its proper time of birth. It turned out to be Puma; the meat is very white, and remarkably like veal in taste. Dr. Shaw was laughed at for stating that, "the flesh of the lion is in great esteem, having no small affinity with veal, both in colour, taste, and flavour." Such certainly is the case with the Puma. The Gauchos differ in their opinion, whether the Jaguar is good eating, but are unanimous in saying that cat is excellent.

September 17th.—We followed the course of the Rio Tapalguen, through a very fertile country, to the ninth posta. Tapalguen itself, or the town of Tapalguen, if it may be so called, consists of a perfectly level plain, studded over as far as the eye can reach, with the toldos, or oven-

* Falconer's Patagonia, p. 70.

shaped huts of the Indians. The families of the friendly Indians, who were fighting on the side of Rosas, resided here. We met and passed many young Indian women, riding by two or three together on the same horse: they, as well as many of the young men, were strikingly handsome,—their fine ruddy complexions being the picture of health. Besides the toldos, there were three ranchos; one inhabited by the Commandant, and the two others by Spaniards with small shops.

We were here able to buy some biscuit. I had now been several days without tasting any thing besides meat: I did not at all dislike this new regimen; but I felt as if it would only have agreed with very hard exercise. I have heard that patients in England, when desired to confine themselves exclusively to an animal diet, even with the hope of life before their eyes, have hardly been able to endure it. Yet the Gaucho in the Pampas, for months together, touches nothing but beef. But they eat, I observe, a very large proportion of fat, which is of a less animalized nature; and they particularly dislike dry meat, such as that of the Agouti. It is, perhaps, from this regimen that the Gauchos, like other carnivorous animals, can abstain long from food. I was told that at Tandeel, some troops voluntarily pursued a party of Indians for three days, without eating or drinking.

We saw in the shops, many articles, such as horsecloths, belts, and garters, woven by the Indian women. The patterns were very pretty, and the colours brilliant; the workmanship of the garters was so good, that an English merchant at Buenos Ayres, maintained they must have been manufactured in England, till he found the tassels had been fastened by split sinew.

September 18th.—We had a very long ride this day. At the twelfth posta, which is seven leagues south of Rio Salado, we came to the first estancia with cattle and white women. Afterwards we had to ride for many miles through a country flooded with water above our horses' knees. By crossing the stirrups, and riding Arab-like with our legs bent up, we

contrived to keep tolerably dry. It was nearly dark when we arrived at the Salado; the stream was deep, and about forty yards wide; in summer, however, its bed becomes almost dry, and the little remaining water nearly as salt as that of the sea. We slept at one of the great estancias of General Rosas. It was fortified, and of such an extent, that arriving in the dark I thought it was a town and fortress. In the morning we saw immense herds of cattle, as well we might, the general here having seventy-four square leagues of land. Formerly nearly three hundred men were employed about this estate, and they defied all the attacks of the Indians.

September 19th.—Passed the Guardia del Monte. This is a nice scattered little town, with many gardens, full of peach and quince trees. The plain here looked like that around Buenos Ayres; the turf being short and bright green, with beds of clover and thistles, and with bizcacha holes. I was very much struck with the marked change in the aspect of the country after having crossed the Salado. From a coarse herbage we passed on to a carpet of fine green verdure. I at first attributed this to some change in the nature of the soil, but the inhabitants assured me that in this part, as well as in Banda Oriental, where there was as great a difference between the country around Monte Video and the thinly-inhabited savannahs of Colonia, that the whole was to be attributed to the manuring and grazing of the cattle. I am not botanist enough to say, whether the change is owing to the introduction of new species, to the altered growth of the same, or to a difference in their proportional numbers. Azara has also observed with astonishment this change: he is likewise much perplexed by the immediate appearance of plants not occurring in the neighbourhood, on the borders of any track that leads to a newly-constructed hovel. In another part he says,* "Ces chevaux (sauvages) ont la manie de préférer les chemins, et le bord des routes pour déposer leurs excrémens, dont on trouve des monceaux dans ces endroits." Does this not

* Azara's Voyage, vol. i., p. 373.

partly explain the circumstance? We thus have lines of richly-manured land serving as channels of communication across wide districts.

Near the Guardia we find the southern limit of two European plants, now become excessively common. The fennel in great profusion covers the ditch banks in the neighbourhood of Buenos Ayres, Monte Video, and other towns. But the cardoon (*Cynara cardunculus*)* has a far wider range: it occurs in these latitudes on both sides of the Cordillera, across the continent. I saw it in unfrequented spots in Chile, Entre Rios, and Banda Oriental. In the latter country alone, very many (probably several hundred) square miles are covered by one mass of these prickly plants, and are impenetrable by man or beast. Over the undulating plains, where these great beds occur, nothing else can live. Before their introduction, however, I apprehend the surface supported as in other parts a rank herbage. I doubt whether any case is on record, of an invasion on so grand a scale of one plant over the aborigines. As I have already said, I nowhere saw the cardoon south of the Salado; but it is probable that in proportion as that country becomes inhabited, the cardoon will extend its limits. The case is different with the giant thistle (with variegated leaves) of the Pampas, for I met with it in the valley of the Sauce. According to the principles so well laid down by Mr. Lyell,

* D'Orbigny (vol. i., p. 474), says that the cardoon and artichoke are both found wild. Dr. Hooker (Botanical Magazine, vol. lv., p. 2862), has described a variety of the Cynara from this part of South America under the name of *inermis*. He states that botanists are now generally agreed that the cardoon and the artichoke are varieties of one plant. I may add, that an intelligent farmer assured me, he had observed in a deserted garden, some artichokes changing into the common cardoon. Dr. Hooker believes that Head's vivid description of the thistle of the Pampas applies to the cardoon; but this is a mistake. Captain Head referred to the plant, which I have mentioned a few lines lower down, under the title of giant thistle. Whether it is a true thistle I do not know; but it is quite different from the cardoon, and more like a thistle properly so called.

few countries have undergone more remarkable changes, since the year 1535, when the first colonist of La Plata landed with seventy-two horses. The countless herds of horses, cattle, and sheep, not only have altered the whole aspect of the vegetation, but they have almost banished the guanaco, deer, and ostrich. Numberless other changes must likewise have taken place; the wild pig in some parts probably replaces the peccari; packs of wild dogs may be heard howling on the wooded banks of the less frequented streams; and the common cat, altered into a large and fierce animal, inhabits rocky hills. I have alluded to the invasion of the cardoon: in a like manner, the islands near the mouth of the Parana, are thickly clothed with peaches and orange-trees, springing from seeds carried there by the waters of the river.

While changing horses at the Guardia, several people questioned us much about the army,—I never saw any thing like the enthusiasm for Rosas, and for the success of the "most just of all wars, because against barbarians." This expression it must be confessed is very natural, for till lately, neither man, woman, nor horse, was safe from the attacks of the Indians. We had a long day's ride over the same rich green plain abounding with various flocks, and with here and there a solitary estancia, and its one *ombu* tree. In the evening it rained heavily: on arriving at a post-house, we were told by the owner that if we had not a regular passport we must pass on, for there were so many robbers he would trust no one. When he read, however, my passport, which began with "El Naturalista Don Carlos, &c." his respect and civility were as unbounded, as his suspicions had been before. What a naturalist may be, neither he nor his countrymen, I suspect, had any idea; but probably my title lost nothing of its value from that cause.

September 20th.—We arrived by the middle of the day at Buenos Ayres. The outskirts of the city looked quite pretty, with the agave hedges, and groves of olive, peach, and willow trees, all just throwing out their fresh green leaves. I rode to the house of Mr. Lumb, an English merchant, to

whose kindness and hospitality, during my stay in the country, I was greatly indebted.

The city of Buenos Ayres is large*; and I should think one of the most regular in the world. Every street is at right angles to the one it crosses, and the parallel ones being equidistant, the houses are collected into solid squares of equal dimensions, which are called quadras. On the other hand, the houses themselves are hollow squares; all the rooms opening into a neat little courtyard. They are generally only one story high, with flat roofs, which are fitted with seats, and are much frequented by the inhabitants in summer. In the centre of the town is the Plaza, where the public offices, fortress, cathedral, &c., stand. Here also, the old viceroys, before the revolution, had their palaces. The general assemblage of buildings possesses considerable architectural beauty, although none individually can boast of any.

The great *corral* where the animals are kept for slaughter to supply food to this beef-eating population, is one of the spectacles best worth seeing. The strength of the horse as compared to that of the bullock is quite astonishing: a man on horseback having thrown his lazo round the horns of a beast, can drag it any where he chooses. The animal having ploughed up the ground with outstretched legs, in vain efforts to resist the force, generally dashes at full speed to one side; but the horse immediately turning to receive the shock, stands so firmly, that the bullock is almost thrown down, and one would think, would certainly have its neck dislocated. The struggle is not, however, one of fair strength; the horse's girth being matched against the bullock's extended neck. In a similar manner a man can hold the wildest horse, if caught with the lazo, just behind the ears. When the bullock has been dragged to the spot where it is to be slaughtered, the *matador* with great caution cuts the hamstrings. Then is given the death bellow; a noise more

* Is said to contain 60,000 inhabitants. Monte Video, the second town of importance on the banks of the Plata, has 15,000.

expressive of fierce agony than any I know: I have often distinguished it from a long distance, and have always known that the struggle was then drawing to a close. The whole sight is horrible and revolting, the ground is almost made of bones; and the horses, and riders are drenched with gore.

CHAPTER VII.

Excursion to St. Fe—Thistle beds—Habits and range of Bizcacha—Little owl—Saline streams—Level plains—Mastodon—St. Fe—Change in landscape—Geology—Tooth of extinct horse—Range of fossil quadrupeds—Pampas full of remains—Effects of great droughts—Droughts periodical—Parana—Habits of Jaguar—Scissor-beak—Kingfisher, parrot, and scissor-tail—Revolution—Buenos Ayres—State of government.

BUENOS AYRES TO ST. FE.

SEPTEMBER 27TH.—In the evening I set out on an excursion to St. Fe, which is situated nearly three hundred English miles from Buenos Ayres, on the banks of the Parana. The roads in the neighbourhood of the city, after the rainy weather were extraordinarily bad. I should never have thought it possible for a bullock waggon to have crawled along: as it was, they scarcely went at the rate of a mile an hour, and a man was kept ahead, to survey the best line for making the attempt. The bullocks were terribly jaded: it is a great mistake to suppose that with improved roads, and an accelerated velocity of travelling, the sufferings of the animals increase in the same proportion. We passed a train of waggons and a troop of beasts on their road to Mendoza. The distance is about 580 geographical miles, and the journey is generally performed in fifty days. These waggons are very long, narrow, and thatched with reeds; they have only two wheels, the diameter of which in some cases is even ten feet. Each is drawn by six bullocks which are urged on by a goad at least twenty feet long: this is suspended from within the roof; for the wheel bullocks a smaller one is kept; and for the intermediate pair, a point projects at right angles from the middle of the long one. The whole apparatus looked like some implement of war.

SEPTEMBER 28TH.—We passed the small town of Luxan,

where there is a wooden bridge over the river—a most unusual convenience in this country. We passed also Areco. The plains appeared level, but were not so in fact; for in various places the horizon was distant. The estancias are here wide apart; for there is little good pasture, owing to the land being covered by beds either of an acrid clover, or of the great thistle. The latter, well known from the animated description given by Sir F. Head, were at this time of the year two-thirds grown; in some parts they were as high as the horse's back, but in others they had not yet sprung up, and the ground was bare and dusty as on a turnpike road. The clumps were of the most brilliant green, and they made a pleasing miniature-likeness of broken forest land. When the thistles are fully grown, the great beds are impenetrable, except by a few tracks, as intricate as those in a labyrinth. These are only known to the robbers, who at this season inhabit them, and sally forth at night to rob, and cut throats, with impunity. Upon asking at a house whether robbers were numerous, I was answered, "The thistles are not up yet;"—the meaning of which reply was not at first very obvious. There is little interest in passing over these tracts, for they are inhabited by few animals or birds, excepting the bizcacha and its friend the little owl.

The bizcacha* is well known to form a prominent feature in the zoology of the Pampas. It is found as far south as the Rio Negro, in lat. 41°, but not beyond. It cannot, like the agouti, subsist on the gravelly and desert plains of Patagonia, but prefers a clayey or sandy soil, which produces a different and more abundant vegetation. Near Mendoza, at the foot of the Cordillera, it occurs in close neighbourhood with the allied alpine species. It is a very curious circumstance in its geographical distribution, that it has never been seen, fortunately for the inhabitants, in Banda Oriental, to the eastward of the river Uruguay: yet in that province

* The bizcacha (*Calomys bizcacha*) somewhat resembles a large rabbit, but with bigger gnawing teeth and a long tail: it has, however, only three toes behind, like the agouti. During the last three or four years, the skins of these animals have been sent to England for the sake of the fur.

there are plains which appear admirably adapted to its habits. That river has formed an insuperable obstacle to its migration; although the broader barrier of the Parana has been passed, and the bizcacha is common in Entre Rios (the province between the two rivers), directly on the opposite shore of the Uruguay. Near Buenos Ayres these animals are exceedingly common. Their most favourite resort appears to be those parts of the plain, which during one half the year are covered with giant thistles, to the exclusion of other plants. The Gauchos affirm that it lives on roots; which, from the great strength of its gnawing teeth, and the kind of localities frequented by it, seems probable. As in the case of the rabbit, a few holes are commonly placed together. In the evening the bizcachas come out in numbers, and there quietly sit on their haunches. They are at such times very tame, and a man on horseback passing by, seems only to present an object for their grave contemplation. They do not wander far from their burrows. They run very awkwardly, and, when hurrying out of danger, from their elevated tails and short front legs much resemble great rats. Their flesh, when cooked, is very white and good, but it is seldom used.

The bizcacha has one very singular habit; namely, dragging every hard object to the mouth of its burrow. Around each group of holes many bones of cattle, stones, thistle-stalks, hard lumps of earth, dry dung, &c., are collected into a scattered heap, which frequently amounts to as much as a wheelbarrow would contain. I was credibly informed that a gentleman, when riding on a dark night, dropped his watch; he returned in the morning, and by searching the neighbourhood of every bizcacha hole on the line of road, as he expected, soon found it. This habit of picking up whatever may be lying on the ground any where near its habitation, must cost much trouble. For what purpose it is done I am quite unable to form even the most remote conjecture: it cannot be for defence, because the rubbish is chiefly placed above the mouth of the burrow, which enters the ground at a very small inclination. No doubt there must exist some good

reason; but the inhabitants of the country are quite ignorant respecting it.

The little owl (*Noctua cunicularia*), which has been so often mentioned, on the plains of Buenos Ayres exclusively inhabits the holes of the bizcacha; but in Banda Oriental it is its own workman. During the open day, but more especially in the evening, these birds may be seen in every direction standing frequently by pairs on the hillock near their burrows. If disturbed they either enter the hole, or, uttering a shrill harsh cry, move with a remarkably undulatory flight to a short distance, and then turning round, steadily gaze at their pursuer. Occasionally in the evening they may be heard hooting. I found in the stomachs of two which I opened the remains of mice, and I one day saw a small snake killed and carried away. It is said these latter animals are their common prey during the daytime. I may here mention, as showing on what various kinds of food owls subsist, that a species that was killed among the islets of the Chonos Archipelago, had its stomach full of good-sized crabs.

In the evening we crossed the Rio Arrecife, on a simple raft made of barrels lashed together, and slept at the post-house on the other side. I this day paid horse hire for thirty-one leagues; and although the sun was glaring hot I was but very little fatigued. When Captain Head talks of riding fifty leagues a day, I do not imagine the distance is equal to 150 English miles. At all events the thirty-one leagues was only 76 miles in a straight line, and in an open country I should think four additional miles for turnings would be a sufficient allowance.

29TH AND 30TH.—We continued to ride over plains of the same character. At San Nicholas I first saw the noble river of the Parana. At the foot of the cliff on which the town stands, some large vessels were at anchor. Before arriving at Rozario, we crossed the Saladillo, a stream of fine clear running water, but too saline to drink. Rozario is a large town built on a dead level plain, which forms

a cliff about sixty feet high over the Parana. The river here is very broad, with many islands, which are low and wooded, as is also the coast of the opposite shore. The view would resemble that of a great lake, if it were not for the linear-shaped islets, which alone give the idea of running water. The cliffs are the most picturesque part; sometimes they are absolutely perpendicular, and of a red colour; at other times in large broken masses, covered with cacti and mimosa-trees. The real grandeur, however, of an immense river like this, is derived from reflecting how important a means of communication and commerce, it forms between one nation and another; to what a distance it travels; and from how vast a territory it drains the great body of fresh water which flows past your feet.

For many leagues north and south of San Nicholas and Rozario, the country is really level. Scarcely any thing which travellers have written about its extreme flatness, can be considered as exaggeration. Yet I could never find a spot, where, by slowly turning round, objects were not seen at greater distances in some directions than in others; and this manifestly proves inequality in the plain. At sea, a person's eye being six feet above the surface of the water, his horizon is two miles and four-fifths distant. In like manner, the more level the plain, the more nearly does the horizon approach within these narrow limits: and this, in my opinion, entirely destroys that grandeur, which one would have imagined that a vast level plain would have possessed.

October 1st.—We started by moonlight and arrived at the Rio Tercero by sunrise. This river is also called the Saladillo, and it deserves the name, for the water is brackish.

I staid here the greater part of the day, searching for fossil bones. Falconer mentions having seen, in the bed of this river, great bones, and the case of a giant armadillo. By good fortune, I discovered a tooth embedded in a layer of rock marl, which was afterwards found exactly to fit the socket in the head of a strange animal, the Toxodon, which

will presently be mentioned. Hearing also of the remains of one of the old giants, which a man told me he had seen on the banks of the Parana, I procured a canoe, and proceeded to the place. Two groups of immense bones projected in bold relief from the perpendicular cliff. They were, however, so completely decayed, that I could only bring away small fragments of one of the great molar-teeth; but these were sufficient to show that the remains belonged to a species of Mastodon. The men who took me in the canoe, said they had long known of them, and had often wondered how they had got there: the necessity of a theory being felt, they came to the conclusion, that, like the bizcacha, the mastodon formerly was a burrowing animal! In the evening we rode another stage, and crossed the Monge, another brackish stream, bearing the dregs of the washings of the Pampas.

October 2d. — We passed through Corunda, which, from the luxuriance of its gardens, was one of the prettiest villages I saw. From this point to St. Fe the road is not very safe. The western side of the Parana further northward, ceases to be inhabited; and hence the Indians sometimes come down, and waylay travellers. The nature of the country also favours this, for instead of a grassy plain, there is an open woodland, composed of low prickly mimosas. We passed some houses that had been ransacked and since deserted; we saw also a spectacle, which my guides viewed with high satisfaction; it was the skeleton of an Indian with the dried skin hanging on the bones, suspended to the branch of a tree.

In the morning we arrived at St. Fe. I was surprised to observe how great a change of climate a difference of only three degrees of latitude between this place and Buenos Ayres had caused. This was evident from the dress and complexion of the men—from the increased size of the ombu-trees—the number of new cacti and other plants—and especially from the birds. In the course of an hour I remarked

half-a-dozen of the latter, which I had never seen at Buenos Ayres. Considering that there is no natural boundary between the two places, and that the character of the country is nearly similar, the difference was much greater than I should have expected.

October 3d and 4th.—I was confined to my bed by a headach for these two days. A goodnatured old woman, who attended me, wished me to try many odd remedies. A common practice is, to bind an orange-leaf, or a bit of black plaster, to each temple; and a still more general plan is, to split a bean into halves, moisten them, and place one on each temple, where they will easily adhere. It is not thought proper ever to remove the beans or plaster, but to allow them to drop off; and sometimes, if a man, with patches on his head, is asked, what is the matter? he will answer, "I had a headache the day before yesterday."

St. Fe is a quiet little town, and is kept clean, and in good order. The governor, Lopez, was a common soldier at the time of the revolution; but has now been seventeen years in power. This stability of government is owing to his tyrannical habits; for tyranny seems as yet better adapted to these countries, than republicanism. The governor's favourite occupation is hunting Indians: a short time since he slaughtered forty-eight, and sold the children at the rate of three or four pounds apiece.

October 5th.—We crossed the Parana to St. Fe Bajada, a town on the opposite shore. The passage took some hours, as the river here consisted of a labyrinth of small streams, separated by low wooded islands. I had a letter of introduction to an old Catalonian Spaniard, who treated me with the most uncommon hospitality. The Bajada is the capital of Entre Rios. In 1825 the town contained 6000 inhabitants, and the province 30,000; yet, few as they are, none have suffered more from bloody and desperate revolutions. They boast here of representatives, ministers, a standing army, and governors: so it is no wonder that they have

their revolutions. At some future day this must be one of the richest countries of La Plata. The soil is varied and productive, and its almost insular form gives it two grand lines of communication by the rivers Parana and Uruguay.

I was delayed here five days, and employed myself in examining the geology of the surrounding country, which was very interesting. We here see beds of sand, clay, and limestone, containing sea-shells and sharks' teeth, passing above into an indurated marl, and from that into the red clayey earth of the Pampas, with its calcareous concretions and the bones of terrestrial animals. This vertical section clearly tells us, of a large bay of pure salt-water, gradually encroached on, and at last becoming the bed of a muddy estuary, into which floating carcasses were swept. I found near the Bajada a large piece, nearly four feet across, of the giant armadillo-like case; also a molar tooth of a mastodon, and fragments of very many bones, the greater number of which were rotten, and as soft as clay.

A tooth which I discovered by one point projecting from the side of a bank, interested me much, for I at once perceived that it had belonged to a horse. Feeling much surprise at this, I carefully examined its geological position, and was compelled to come to the conclusion,* that a horse, which cannot from a comparison of the tooth alone, be distinguished from the existing species,† lived as a contemporary with the various great monsters that formerly inhabited South America. Mr. Owen and myself, at the College of Surgeons, compared this tooth with a fragment of another, probably belonging to the Toxodon, which was embedded at the dis-

* The broken tooth mentioned at Bahia Blanca must not be forgotten.

† As this horse existed at the same time with animals now extinct, it is not probable, that it is the same species with the recent kind, although from the similarity of the teeth it must have been closely allied. Cuvier, talking of the remains of the horse, found fossil under similar conditions in Europe, remarks, "It is not possible to say whether it was one of the species now existing or not, because the skeletons of these species are so like each other, that they cannot be distinguished by the mere comparison of isolated fragments."—*Theory of the Earth*, English translation, p. 285.

tance only of a few yards in the same earthy mass. No sensible difference in their state of decay could be perceived; they were both tender, and partially stained red. If the horse did not coexist with the Toxodon, the tooth must by some accident, not very easily understood, have been embedded within the last three centuries (the period of the introduction of the horse), with the remains of those animals, which ages since perished, when the Pampas was covered by the waters of the sea. Now, I may ask, will any one credit that two teeth of nearly equal size, buried in the same substance close together, after a period of so vast an inequality, could exist in the same condition of decay? We must conclude otherwise. Certainly it is a marvellous event in the history of animals, that a native kind should have disappeared* to be succeeded in after ages by the countless herds introduced with the Spanish colonist! But our surprise should be modified when it is already known, that the remains of the *Mastodon angustidens* (the tooth formerly alluded to as embedded near that of the horse, probably belonged to this species) have been found both in South America, and in the southern parts of Europe.

With regard to North America, Cuvier says† the *Elephas primigenius* "has left thousands of its carcasses from Spain to the shores of Siberia, and it has been found in the whole of North America." The fossil ox, in a like manner, he writes,‡ is buried "dans toute la partie boréale des deux continens, puisque on en a d'Allemagne, d'Italie, de Prussie, de la Sibérie occidentale et orientale, et de l'Amérique." I may here add that horses' bones, mingled with those of the mastodon, have several times been transmitted for sale from North America to England; but it has always been imagined, from the simple fact of their being horses' bones, that they had been accidentally mingled with the fossils. Among the

* I need not here state, that there is no kind of evidence to support the belief, that a horse existed in America previously to the age of Columbus.

† Theory of the Earth, p. 281 (English translation).

‡ Ossemens Fossiles, vol. iv., p. 147.

remains brought home by Captain Beechey from the west coast of the same continent, in the frozen region of 66° north, Dr. Buckland* has described the astragalus metacarpus, and metatarsus of the horse, which were associated with the remains of the *Elephas primigenius*, and of the fossil ox. Thus we have an elephant, an ox, and a horse (the species of the latter is only presumed to be identical), common to Europe and to North America.

Very few species of living quadrupeds,† which are altogether terrestrial in their habits, are common to the two continents, and these few are chiefly confined to the extreme frozen regions of the north. The separation, therefore, of the Asiatic and American zoological provinces appears formerly to have been less perfect than at present. The remains of the elephant and of the ox have been found on the banks of the Anadir (long. 175° E.), on the extreme part of Siberia, nearest the American coast: and the former remains, according to Chamisso, are common in the peninsula of Kamtschatka. On the opposite shores, likewise, of the narrow strait which divides these two great continents, we know, from the discoveries of Kotzebue and Beechey, that the remains of both animals occur abundantly: and as Dr. Buckland has shown they are associated with the bones of the horse, the teeth of which animal in Europe, according to Cuvier, accompany by thousands the remains of the pachydermata of the later periods. With these facts, we may safely look at this quarter, as the line of communication (now interrupted by the steady progress of geological change) by which the elephant, the ox, and the horse, entered America, and peopled its wide extent.‡

* See the admirable Appendix to Beechey's Voyage, p. 592 (quarto edition).

† See Dr. Richardson's very interesting Report on North American Zoology for the British Association of 1836.

‡ I do not here mean to fix on the more northern parts of the old world as the parent country of these two animals. I only want to point out the channel of communication—not the course of the stream—

The occurrence of the fossil horse and of *Mastodon angustidens* in South America, is a much more remarkable circumstance than that of the animals mentioned above in the northern half of the continent; for if we divide America, not by the Isthmus of Panama, but by the southern part of Mexico,* in lat. 20°, where the great table-land presents an obstacle to the migration of species, by affecting the climate, and by forming, with the exception of some valleys and of a fringe of low land on the coast, a broad barrier; we shall then have two zoological provinces strongly contrasted with each other. Some few species alone have passed the barrier, and may be considered as wanderers, such as the puma, opossum, kinkajou, and peccari. The mammalogy of South America is characterized by possessing several species of the genera of llama, cavy (and the allied animals), tapir, peccari, opossum, anteater, sloth, and armadillo. If North America had possessed species of these genera proper to it, the distinction of the two provinces could not have been drawn; but the presence of a few wanderers scarcely affects the case. North America, on the other hand, is characterized by its numerous rodents,† and by four genera of solid horned ruminants,‡ of which section the southern half does not possess a single species.

whether from west to east, or the reverse. Perhaps, when we recollect how extraordinarily the Pachydermata abounded during the Tertiary epochs in the Old World, and that the representatives of these animals now only exist in that quarter, it may seem most probable that the migration took place from Asia to America.

* This is the division followed by Lichtenstein, Swainson, and Richardson. The section from Vera Cruz to Acapulco, given by Humboldt in the Atlas to Polit. Essay on Kingdom of N. Spain, will show how immense a barrier the Mexican table-land forms.

† Dr. Richardson (Report to Brit. Assoc., p. 157), talking of the identification of a Mexican animal with the *Synetheres prehensilis*, says, "We do not know with what propriety, but, if correct, it is, if not a solitary instance, at least very nearly so, of a rodent animal being common to North and South America."

‡ *Dicranocerus furcifer, Capra Americana, Ovis montana, Bos Americana,* and *Moschatus.*—Report to Brit. Assoc., p. 159.

This distinction of the two zoological provinces does not appear always to have existed. At the present day the order of Edentata is much more strongly developed in South America, than in any other part of the world: and concluding from the fossil remains, which were discovered at Bahia Blanca, such must have been the case during a former epoch. In America, north of Mexico, not one of this order is now found: yet, as is well known, the gigantic megalonyx, considered by Cuvier as a species of Megatherium, has been found only in that country; and as it appears from recent observations,* the Megatherium Cuvierii itself likewise occurs there. Mr. Owen showed me the tibia of some large animal, which Sir Philip Egerton had purchased out of a collection of the remains of the mastodon brought from North America. Mr. Owen says it certainly belongs to one of the Edentata, and it so closely resembles a bone which I found embedded, together with fragments of the great armadillo-like covering, in Banda Oriental, that it probably forms a species of the same genus. Lastly, among the fossils brought home by Captain Beechey from the N.W. coast, there was a cervical vertebra, which, when compared by Mr. Pentland† with the skeletons at Paris, was found to resemble that of the sloth and anteater more than that of any other animal, although having some points of essential difference.

Of the Pachydermata four or five species are now found in America; but, as in the case of the Edentata, none are peculiar to the continent north of Mexico; and one alone seems to exist there as a wanderer. Yet the account of the multitude of bones of the mastodon and elephant, which have been discovered in the salt-licks of North America, is familiar to every one. The remains of the *Mastodon giganteum* have been found nowhere else; but those of the *Elephas primigenius* are common to a large part of the

* Ed. New Phil. Journal. July, 1828, p. 327. From a paper by Mr. Cooper in the Lyceum of Natural History of New York.

† See Dr. Buckland. Appendix to Beechey's Voyage, p. 597.

terrestrial globe.* This elephant must have existed in Mexico; and Cuvier,† judging from a fragment of a tusk, thinks it even extended to the neighbourhood of Quito in South America. In the latter country three species of Mastodon have been discovered. One of these, *M. angustidens*, is common to Europe. It is singular that its remains, as yet, have never been brought from North America; nevertheless, considering that it was a contemporary of the extinct animals above mentioned, it seems highly probable that it arrived by the same line of communication on the N.W. coast. As its remains have frequently been found at a great elevation in the Cordillera, perhaps its habits led it to follow that chain of mountains from north to south.

After these facts, it is only in conformity with what we might almost have expected, that the horse, belonging to the same order of Pachydermata, should formerly have inhabited both North and South America. It is interesting thus to discover an epoch anterior to the division, as far at least as two important orders among the mammalia are concerned, of the continent into two separate zoological provinces. The geologist who believes in considerable oscillations of level in the crust of the globe within recent periods, will not fear to speculate either on the elevation of the Mexican platform, as a cause of the distinction, or on the submergence of land in the West Indian seas,—a circumstance which is perhaps indicated by the zoology of those islands.‡

* I may observe that at the present day both species of elephants have wide ranges. The African one is found from the Senegal to the Cape of Good Hope, a distance of about 3000 miles. The Asiatic kind formerly had an equal range, namely, from the banks of the Indus to the East Indian Isles. The hippopotamus is believed to have reached from the Cape to Egypt.

† Ossemens Fossiles, vol. i., p. 158. Cuvier says he cannot decide positively, not having seen a molar tooth.

‡ Dr. Richardson (Report for 1836, to Brit. Assoc., p. 157) says, "the spotted cavy (*cœlogenys*), and perhaps a species of *cavia*, and one *dasyprocta*, extend from South America to the West Indies and Mexico." Cuvier says the Kinkajou is found in the larger Antilles, but others

The number of bones embedded in the grand estuary deposit of the Pampas must he very great; I myself heard of, and saw many groups. The names of such places as "the stream of the animal," "the hill of the giant," tell the same story. At other times I heard of the marvellous property of certain rivers, which had the power of changing small bones into large; or as some maintained, the bones themselves grew. As far as I am aware, not one of these animals, as was formerly supposed, perished in the marshes, or muddy river-beds of the present land, but their bones have been exposed by the streams intersecting the deposit in which their remains were formerly buried. We may therefore conclude that the whole area of the Pampas is one wide sepulchre for these extinct quadrupeds.

While travelling through the country, I received several vivid descriptions of the effect of a great drought; and the account of this may throw some light on the cases, where vast numbers of animals of all kinds, have been embedded together. The period included between the years 1827 and 1830 is called the "gran seco" or the great drought. During this time, so little rain fell, that the vegetation, even to the thistles, failed; the brooks were dried up, and the whole country assumed the appearance of a dusty high-road. This was especially the case in the northern part of the province of Buenos Ayres, and the southern part of St. Fe. Very great numbers of birds, wild animals, cattle, and horses, perished from the want of food and water. A man told me, that the deer* used to come into his courtyard to the well,

affirm that this is an error: according to M. Gervais, the *Didelphis crancrivora* inhabits the Antilles. A tooth of the Mastodon has been brought from Bahama (Ed. New Phil. Journal, July, 1826, p. 395). We cannot, however, from this conclude, that the Mastodon formerly inhabited those islands, for the carcass might have been floated there. Some mammalia certainly are peculiar to the Archipelago.

* In Capt. Owen's Surveying Voyage (vol. ii., p. 274) there is a curious account of the effects of a drought on the elephants, at Benguela (west coast of Africa). "A number of these animals had sometime since entered the

which he had been obliged to dig to supply his own family with water; and that the partridges had hardly strength to fly away when pursued. The lowest estimation of the loss of cattle in the province of Buenos Ayres alone, was taken at one million head. A proprietor at San Pedro had previously to these years 20,000 cattle; at the end not one remained. San Pedro is situated in the middle of the finest country; and even now again abounds with animals; yet, during the latter part of the "gran seco," live cattle were brought in vessels for the consumption of the inhabitants. The animals roamed from their estancias, and wandering far to the southward, were mingled together in such multitudes, that a government commission was sent from Buenos Ayres to settle the disputes of the owners. Sir Woodbine Parish informed me of another and very curious source of dispute; the ground being so long dry, such quantities of dust were blown about, that in this open country the landmarks became obliterated, and people could not tell the limits of their estates.

I was informed by an eyewitness, that the cattle in herds of thousands rushed into the Parana,* and being exhausted by hunger they were unable to crawl up the muddy banks, and thus were drowned. The arm which runs by San Pedro was so full of putrid carcasses, that the master of a vessel told me, that the smell rendered it quite impossible to pass that way. Without doubt several hundred thousand animals thus perished in the river. Their bodies when putrid floated down the stream, and many in all probability were deposited

town, in a body, to possess themselves of the wells, not being able to procure any water in the country. The inhabitants mustered, when a desperate conflict ensued, which terminated in the ultimate discomfiture of the invaders, but not until they had killed one man, and wounded several others." The town is said to have a population of nearly three thousand!

* Azara talks of the fury of the wild horses rushing into the marshes during a dry season: "et les premiers arrivés sont foulés, et écrasés par ceux, qui les suivent. Il m'est arrivé plus d'une fois de trouver plus de mille cadavres de chevaux sauvages morts de cette façon."—Vol. i., p. 374.

in the estuary of the Plata. All the small rivers became highly saline, and this caused the death of vast numbers in particular spots; for when an animal drinks of such water it does not recover. I noticed, but probably it was the effect of a gradual increase, rather than of any one period, that the smaller streams in the Pampas were paved with a breccia of bones.* Subsequently to this unusual drought a very rainy season commenced, which caused great floods. Hence it is almost certain, that some thousands of these skeletons were buried by the deposits of the very next year. What would be the opinion of a geologist, viewing such an enormous collection of bones, of all kinds of animals and of all ages, thus embedded in one thick earthy mass? Would he not attribute it to a flood having swept over the surface of the land, rather than to the common order of things?

These droughts to a certain degree seem to be periodical; I was told the dates of several others, and the intervals were about fifteen years. A tendency to periodical droughts is, I believe, common in most dry climates :† such certainly is the case in Australia. Captain Sturt says they return after every ten and twelve years, and are then followed by excessive rains, which gradually become less and less, till another drought is the consequence. The year 1826 and the two following were singularly dry in Australia, and the latter were the first of the "gran seco." I mention this, because

* In the neighbourhood of the great towns on the shores of the Plata, the number of bones strewed over the ground is truly astonishing. Since our return I have been informed, that ships have been freighted to this country with a cargo of bones. That cattle should be fattened on turnips manured with the bones of animals that lived in the southern hemisphere, is a curious fact in the commerce of the world In the East Indies the luxurious drink wine cooled with North-American ice, which in its journey has twice crossed the equator!

† Perhaps in every country, but the effect is more marked where the mean annual quantity of rain is small. I have seen the trunk of an old tree in England, in which the successive rings showed a tendency to periodical increase and diminution of size; about every tenth ring being small. See Mr. Babbage's Ninth Bridgewater Treatise. Note M.

General Beatson in his account of the island of St. Helena, has remarked that variations in climate sometimes appear to be the effect of the operation of some very general cause. He says (page 43), "The severe drought felt here in 1791 and 1792, was far more calamitous in India. Doctor Anderson states, in a letter to Colonel Kyd, dated the 9th of August, 1792, that, owing to a failure of rain, during the above two years, one half of the inhabitants in the northern provinces had perished by famine; and the remainder were so feeble and weak, that on the report of rice coming from the Malabar coast, 5000 poor people left Rajamundy, and very few of them reached the sea-side, although the distance is only 50 miles. It appears by Mr. Bryan Edwards's History of the West Indies, that the seasons 1791-2 were unusually dry at the island of Montserrat." Barrow* in the latter part of 1792, when at the Cape de Verd islands says, "In fact a drought of three years' continuance, and consequent famine for almost the same period, had nearly desolated the island."

October 12th.—I had intended to have pushed my excursion further, but not being quite well, I was compelled to return by a balandra, or one-masted vessel of about a hundred tons burden, which was bound to Buenos Ayres. As the weather was not fair, we moored early in the day to a branch of a tree on one of the islands. The Parana is full of islands, which undergo a constant round of decay and renovation. In the memory of the master several large ones had disappeared, and others again had been formed and protected by vegetation. They are composed of muddy sand, without even the smallest pebble, and were then about four feet above the level of the river; but during the periodical floods they are inundated. They all present one character; numerous willows and a few other trees are bound together by a great variety of creeping plants, thus forming a thick jungle. These thickets afford a retreat for carpinchos and jaguars.

* Voyage to Cochin China, p. 67.

The fear of the latter animal, quite destroyed all pleasure in scrambling through the woods. This evening I had not proceeded a hundred yards, before finding indubitable signs of the recent presence of the tiger, I was obliged to come back. On every island there are tracks; and as on the former excursion "el rastro de los Indios" had been the subject of conversation, so in this was "el rastro del tigre."

The wooded banks of the great rivers appear to be the favourite haunt of the jaguar; but south of the Plata, I was told, they frequented the reeds bordering lakes: wherever they are, they seem to require water. The jaguar has been killed on the banks of the Rio Negro, in lat. 41°; and Falconer states that the lake Nahuel-huapi, takes its name from the Indian word for tiger: the latitude of this lake is about 42°; which corresponds to the situation of the Pyrenees in the northern hemisphere. These animals are particularly abundant on the isles of the Parana; their common prey is the carpincho, so that it is generally said, where the carpinchos are plentiful there is little danger of the jaguar. Falconer states, that near the mouth of the Plata, on the southern side, the jaguars are numerous, and that they chiefly live on fish; this account I have heard repeated. On the Parana they have killed many wood-cutters, and have even entered vessels at night. There is a man now living in the Bajada, who, coming up from below when it was dark, was seized on the deck; he escaped, however, with the loss of the use of one arm. When the floods drive these animals from the islands they are most dangerous. I was told, that a few years since, a very large one found its way into a church at St. Fe: two padres entering one after the other were killed, and a third, who came to see what was the matter, escaped with difficulty. The beast was destroyed by being shot from a corner of the building which was unroofed. They commit also at these times great ravages among the cattle and horses. It is said they kill their prey by breaking the vertebræ of the neck. If driven from the carcass they seldom return to it. The Gauchos say that the jaguar, when

wandering about at night, is much tormented by the foxes yelping as they follow him. This is a curious coincidence with the fact which is generally affirmed of the jackals accompanying, in a similarly officious manner, the East Indian tiger. The jaguar is a noisy animal, roaring much by night, and especially before bad weather.

One day, when hunting on the banks of the Uruguay, I was shown certain trees, to which these animals are said constantly to recur, for the purpose of sharpening their claws. I saw three well-known trees; in front the bark was worn smooth, and on each side there were deep scratches, or rather grooves, extending in an oblique line, nearly a yard in length. The scars were of different ages. A common method of ascertaining whether a jaguar is in the neighbourhood, is to examine these trees. I imagine this habit of the jaguar is exactly similar to one, which may any day be seen in the common cat, as with outstretched legs and exserted claws it scrapes the leg of a chair. Some such habit must be also common to the puma, for on the bare hard soil of Patagonia I have frequently seen scores so deep, that no other animal could have made them. The object of this practice is, I should think, to blunt rather than to sharpen (as the Gauchos say), the points of their claws, which are so seldom used. The jaguar is killed, without much difficulty, by the aid of dogs baying and driving him up a tree, where he is despatched with bullets.

Owing to bad weather we remained two days at our moorings. Our only amusement was catching fish for our dinner: there were several kinds, and all good eating. A fish called the "armado" (a Silurus), is remarkable from a harsh grating noise it makes when caught by hook and line, and which can be distinctly heard when the fish is beneath the water. This same fish has the power of firmly catching hold of any object, such as the blade of an oar or the fishing-line, with the strong spine both of its pectoral and dorsal fin. In the evening the weather was quite tropical, the thermometer standing at 79°. Numbers of fireflies were hovering about,

and the musquitoes were very troublesome. I exposed my hand for five minutes, and it was soon black with them; I do not suppose there could have been less than fifty, all busy sucking.

October 15th.—We got under way and passed Punta Gorda, where there is a colony of tame Indians, from the province of Missiones. We sailed rapidly down the current, but before sunset, from a silly fear of bad weather, we brought to in a narrow arm of the river. I took the boat and rowed some distance up this creek. It was very narrow, winding, and deep; on each side, a wall thirty or forty feet high, formed by trees intwined with creepers, gave to the canal a singularly gloomy appearance. I here saw a very extraordinary bird, called the Scissor-beak (*Rhyncops nigra*). It has short legs, web feet, extremely long-pointed wings, and is of about the size of a tern. The beak is flattened laterally, that is, in a plane at right angles to that of a spoonbill, or duck. It is as flat and elastic as an ivory paper-cutter, and the lower mandible, differently from every other bird, is an inch and a half longer than the upper. I will here detail all I know of the habits of the scissor-beak. It is found both on the east and west coasts, between lat. 30° and 45°, and frequents either salt or fresh water. The specimen now at the Zoological Society was shot at a lake near Maldonado, from which the water had been nearly drained, and which, in consequence, swarmed with small fry. I there saw several of these birds, generally in small flocks, flying backwards and forwards, close to the surface of the lake. They kept their bills wide open, and with the lower mandible half buried in the water. Thus skimming the surface, they ploughed it in their course: the water was quite smooth, and it formed a most curious spectacle to behold a flock, each bird leaving its narrow wake on the mirror-like surface. In their flight they frequently twist about with extreme rapidity, and so dexterously manage, that with their projecting lower mandible they plough up small fish, which are secured by the upper half of their scissor-like bills. This fact I repeatedly saw, as,

like swallows, they continued to fly backwards and forwards, close before me. Occasionally when leaving the surface of the water their flight was wild, irregular, and rapid; they then also uttered loud harsh cries. When these birds are fishing, the length of the primary feathers of the wings is seen to be quite necessary, in order to keep the latter dry. When thus employed, their forms resemble the symbol by which many artists represent marine birds. The tail is much used in steering their irregular course.

These birds are common far inland along the course of the Rio Parana; it is said they remain during the whole year, and breed in the marshes. During the day they rest in flocks on the grassy plains, at some distance from the water. Being at anchor, as I have said, in one of the deep creeks between the islands of the Parana, as the evening drew to a close, one of these scissor-beaks suddenly appeared. The water was quite still, and many little fish were rising. The bird continued for a long time to skim the surface, flying in its wild and irregular manner up and down the narrow canal, now dark with the growing night and the shadows of the overhanging trees. At Monte Video I observed that some large flocks during the day remained on the mud-banks at the head of the harbour, in the same manner as on the grassy plains near the Parana; and every evening they took flight direct to seaward. From these facts, I suspect that the Rhyncops generally fishes by night, at which time many of the lower animals come most abundantly to the surface. M. Lesson states that he has seen these birds opening the shells of the mactræ, buried in the sand-banks on the coast of Chile: from their weak bills, with the lower mandible so much produced, their short legs and long wings, it is very improbable that this can be a general habit.

In our course down the Parana, I only observed three other birds, whose habits are worth mentioning. One is a small kingfisher (*Alcedo Americana*); it has a longer tail than the European species, and hence does not sit in so stiff and upright a position. Its flight also, instead of being direct

and rapid, like the course of an arrow, is weak and undulatory, as among the soft-billed birds. It utters a low note, like the clicking together of two small stones. A small green parrot,* with a gray breast, appears to prefer the tall trees on the islands, to any other situation, for its building-place. A number of nests are placed so close together, as to form one great mass of sticks. These parrots always live in flocks, and commit great ravages on the corn-fields. I was told, that near Colonia 2500 were killed in the course of one year. A bird (*Milvulus forficatus*) with a forked tail, terminated by two long feathers, and named by the Spaniards scissor-tail, is very common near Buenos Ayres. It commonly sits on a branch of the *ombu* tree, near the house, and thence takes a short flight in pursuit of insects, and returns to the same spot. When on the wing, it presents, in its manner of flight and general appearance, a caricature-likeness of the common swallow. It has the power in the air of turning very shortly, and in so doing, opens and shuts its tail, sometimes in a horizontal or lateral, and sometimes in a vertical direction, just like a pair of scissors. In structure, this bird is a true tyrant-flycatcher, although in its habits certainly allied to the swallows.

October 16th.—Some leagues above Rozario the western shore was bounded by perpendicular cliffs, which extended in a long line to below San Nicholas. Hence the coast more resembled that of the sea, than that of a fresh-water river. It is a great drawback to the scenery of the Parana, that, from the soft nature of its banks, the water is very muddy. The Uruguay, flowing through a granitic country, is much clearer; and I am told, that where the two channels unite at the head of the Plata, the waters may for a long distance be distinguished by their black and red colours. In the evening, the wind not being quite fair, as usual we immediately moored, and the next day, as it blew rather freshly, though

* *La jeune Veuve* of Azara. Latham Gen. Hist., vol. ii., p. 192.

with a favouring current, the master was much too indolent to think of starting. At Bajada, he was described to me as "hombre muy aflicto,"—a man always miserable to get on; but certainly he bore all delays with admirable resignation. He was an old Spaniard, and had been many years in this country. He professed a great liking to the English, but stoutly maintained that the battle of Trafalgar was merely won by the Spanish captains having been all bought over; and that the only really gallant action on either side was performed by the Spanish admiral. It struck me as rather characteristic, that this man should prefer his countrymen being thought the worst of traitors, rather than unskilful or cowardly.

18TH AND 19TH.—We continued slowly to sail down the noble stream: the current helped us but little. Azara has estimated that even near the sources between latitudes 16° 24′ and 22° 57′, the river has only a fall of one foot for each mile of latitude; lower down, this must be much diminished. It is stated that a rise of seven feet at Buenos Ayres can be perceived sixty leagues up the course of the Parana. We met, during our descent, very few vessels. One of the best gifts of nature seems here wilfully thrown away, in so grand a channel of communication being left unoccupied. A river in which ships might navigate from a temperate country, as surprisingly abundant in certain productions as destitute of others, to another possessing a tropical climate, and a soil which, according to the best of judges, M. Bonpland, is perhaps unequalled in fertility, in any part of the world. How different would have been the aspect of this river, if English colonists had by good fortune first sailed up the Plata! What noble towns would now have occupied its shores! Till the death of Francia, the Dictator of Paraguay, these two countries must remain distinct, as if placed on opposite sides of the globe. And when the old, bloody-minded tyrant is gone to his long account, Paraguay will be torn by revolutions, violent in proportion to the previous unnatural calm. That country

will have to learn, like every other South American state, that a republic cannot succeed, till it contains a certain body of men imbued with the principles of justice and honour.

October 20th.—Being arrived at the mouth of the Parana, and as I was very anxious to reach Buenos Ayres, I went on shore at Las Conchas, with the intention of riding there. Upon landing, I found to my great surprise, that I was to a certain degree a prisoner. A violent revolution having broken out, all the ports were laid under an embargo. I could not return to my vessel, and as for going by land to the city, it was out of the question. After a long conversation with the Commandant, I obtained permission to go, the next day, to General Rolor, who commanded a division of the rebels, on this side of the capital. In the morning I rode to the encampment. The general, officers, and soldiers, all appeared, and I believe really were, great villains. The general the very evening before he left the city, voluntarily went to the governor, and with his hand to his heart, pledged his word of honour, that he would remain faithful to the last. The general told me, that the city was in a state of close blockade, and that all he could do was to give me a passport to the commander-in-chief of the rebels at Quilmes. We had, therefore, to take a great sweep round the city, and it was with much difficulty that we procured horses. My reception at the encampment was quite civil, but I was told it was impossible that I could be allowed to enter the city. I was very anxious about this, as I anticipated the Beagle's departure from the Rio Plata, earlier than it took place. Having mentioned, however, General Rosas's obliging kindness to me when at the Colorado, magic itself could not have altered circumstances quicker than did this conversation. I was instantly told that though they could not give me a passport, if I chose to leave my guide and horses, I might pass their sentinels. I was too glad to accept of this, and an officer was sent with me to give directions, that I might not be stopped at the bridge. The road for the space of a league was quite deserted. I met one party of

soldiers, who were satisfied by gravely looking at an old passport: and at length I was not a little pleased, to find myself within the city.

This revolution was supported by scarcely any pretext of grievances. But in a state which, in the course of nine months (from February to October, 1820), underwent fifteen changes in its government—each governor, according to the constitution, being elected for three years—it would be the height of illiberality, to ask for pretexts. In this case a party of men, who being attached to Rosas, were disgusted with the governor Balcarce, to the number of seventy left the city, and with the cry of Rosas, the whole country took arms. The city was then blockaded, no provisions, cattle, or horses, were allowed to enter; besides this, there was only a little skirmishing, and a few men daily killed. The outside party well knew, that by stopping the supply of meat, they would certainly be victorious. General Rosas could not have known of this rising; but it appears to me quite consonant with the plans of his party. A year ago he was elected governor, but he refused it, without the Sala would also confer on him extraordinary powers. This was refused, and since then his party have shown, that no other governor can keep his place. The warfare on both sides was avowedly protracted, till it was possible to hear from Rosas. A note arrived a few days after I left Buenos Ayres, which stated that the General disapproved of peace having been broken, but that he thought the outside party had justice on their side. On the bare reception of this, the Governor, ministers, and part of the military, to the number of some hundreds, fled from the city. The rebels entered, elected a new governor, and were paid for their services to the number of 5500 men. From these proceedings, it was clear that Rosas ultimately would become the dictator: to the term king, the people in this, as in other republics, have a particular dislike. Since leaving South America, we have heard that Rosas has been elected, with powers, and for a time altogether opposed to the constitutional principles of the republic.

CHAPTER VIII.

Monte Video—Excursion to Colonia del Sacramiento—Horse swimming—Value of an Estancia—Cattle, how counted—Geology—Great thistle-beds—Rio Negro—Perforated pebbles—Shepherd dogs—Horses broken in, Gauchos riding, feats with lazo—Toxodon—Armadillo-like gigantic covering—Great tail—Return to Monte Video—Character of inhabitants.

BANDA ORIENTAL.

Having been delayed for nearly a fortnight in the city, I was glad to escape on board a packet bound for Monte Video. A town in a state of blockade must always be a disagreeable place of residence; in this case moreover there were constant apprehensions from robbers within. The sentinels were the worst of all; for, from their office and from having arms in their hands, they robbed with a degree of authority, which other men could not imitate.

Our passage was a very long and tedious one. The Plata looks like a noble estuary on the map; but it is in truth a poor affair. A wide expanse of muddy water, has neither grandeur nor beauty. At one time of the day the two shores, both of which are extremely low, could just be distinguished from the deck. On arriving at Monte Video I found the Beagle would not sail for some time, so I prepared for a short excursion in this part of Banda Oriental. Every thing which I said about the country near Maldonado is applicable to this; the land, however, with the one exception of the Green Mount, 450 feet high, from which it takes its name, is far more level. Very little of the undulating grassy plain is enclosed; but near the town there are a few hedge banks, covered with agaves, cacti, and fennel.

November 14th.—We left Monte Video in the afternoon. I intended to proceed to Colonia del Sacramiento, situated on the northern bank of the Plata and opposite to

Buenos Ayres, and thence following up the Uruguay, to the village of Mercedes on the Rio Negro (one of the many rivers of this name in South America), and from this point to return direct to Monte Video. We slept at the house of my guide at Canelones. In the morning we rose early in the hopes of being able to ride a good distance; but it was a vain attempt, for all the rivers were flooded. We passed in boats the streams of Canelones, St. Lucia, and San Josè, and thus lost much time. On a former excursion I crossed the Lucia, near its mouth, and I was surprised to observe how easily our horses, although not used to swim, passed over a width of at least six hundred yards. On mentioning this at Monte Video I was told that a vessel containing some mountebanks and their horses, being wrecked in the Plata, one horse swam seven miles to the shore. In the course of the day I was amused by the dexterity with which a Gaucho forced a restive horse to swim a river. He stripped off his clothes, and jumping on its back, rode into the water till it was out of its depth; then slipping off over the crupper, he caught hold of the tail, and as often as the horse turned round, the man frightened it back, by splashing water in its face. As soon as the horse touched the bottom on the other side, the man pulled himself on, and was firmly seated, bridle in hand, before the horse gained the bank. A naked man, on a naked horse, is a fine spectacle; I had no idea how well the two animals suited each other. The tail of a horse is a very useful appendage; I have passed a river in a boat with four people in it, which was ferried across in the same way as the Gaucho. If a man and horse have to cross a broad river, the best plan is for the man to catch hold of the pummel or mane, and help himself with the other arm.

We slept, and staid the following day at the post of Cufre. In the evening the postman or letter-carrier arrived. He was a day after his time, owing to the Rio Rozario being flooded. It would not, however, be of much consequence; for, although he had passed through some of the principal

towns in Banda Oriental, his luggage consisted of two letters. The view from the house was pleasing; an undulating green surface, with distant glimpses of the Plata. I find I look at this province with very different eyes, from what I did upon my first arrival. I recollect I then thought it singularly level; but now, after galloping over the Pampas, my only surprise is, what could have induced me ever to have called it level. The country is a series of undulations, in themselves perhaps not absolutely great, but as compared to the plains of St. Fe, real mountains. From these inequalities, there is an abundance of small rivulets, and the turf is green and luxuriant.

November 17th.—We crossed the Rozario, which was deep and rapid, and passing the village of Colla, arrived at mid-day at Colonia del Sacramiento. The distance is twenty leagues, through a country covered with fine grass, but poorly stocked with cattle or inhabitants. I was invited to sleep at Colonia, and to accompany on the following day a gentleman to his estancia, where there were some limestone rocks. The town is built on a stony promontory something in the same manner as at Monte Video. It is strongly fortified; but both fortifications and town suffered much from the Brazilian war. It is very ancient; and the irregularity of the streets, and the surrounding groves of old orange and peach trees gave it a pretty appearance. The church is a curious ruin; it was used as a powder-magazine, and was struck by lightning in one of the ten thousand thunderstorms of the Rio Plata. Two-thirds of the building were blown away to the very foundation; and the rest stands a shattered and curious monument, of the united powers of lightning and gunpowder. In the evening I wandered about the half-demolished walls of the town. It was the chief seat of the Brazilian war;—a war most injurious to this country, not so much in its immediate effects, as in being the origin of a multitude of generals and all other grades of officers. More generals are numbered (but not paid) in the United Provinces of la Plata, than in the United Kingdom of Great

Britain. These gentlemen have learned to like power, and do not object to a little skirmishing. Hence there are many, always on the watch to create disturbance and to overturn a government, which as yet has never rested on any stable foundation. I noticed however, both here and in other places, a very general interest in the ensuing election for the President; and this appears a good sign for the prosperity of this little country. The inhabitants do not require much education in their representatives; I heard some men discussing the merits of those for Colonia; and it was said that, "although they were not men of business, they could all sign their names:" with this every reasonable man was satisfied.

18TH.—Rode with my host to his estancia, at the Arroyo de San Juan. In the evening we took a ride round the estate. It contained two square leagues and a half; and was situated in what is called a rincon; that is, one side was fronted by the Plata, and the two others guarded by impassable brooks. There was an excellent port for little vessels, and an abundance of small wood, which is valuable as supplying fuel to Buenos Ayres. I was curious to know the value of so complete an estancia. Of cattle there were 3000, and it would well support three or four times that number; of mares 800, together with 150 broken horses, and 600 sheep. There was plenty of water and limestone, a rough house, excellent corrals, and a peach orchard. For all this he had been offered 2000*l.*, and only wanted 500*l.* additional, and probably would sell it for less. The chief trouble with an estancia, is driving the cattle twice a week to a central spot, in order to make them tame, and to count them. This latter operation would be thought difficult, where there are ten or fifteen thousand head together. It is managed on the principle that the cattle invariably divide themselves into little troops of from forty to one hundred. Each troop is recognised by a few peculiarly marked animals, and its number is known: so that, one being lost out of ten thousand, it is perceived by its absence from one of the tropillas.

During a stormy night the cattle all mingle together; but the next morning the tropillas separate as before.

November 19th.—Passing the village of Las Vacas, we slept at a house of a North American, who worked a lime-kiln on the Arroyo de las Vivoras. In the morning we rode to a projecting headland on the banks of the river, called Punta Gorda. On the way we tried to find a jaguar. There were plenty of fresh tracks, and we visited the trees, on which they are said to sharpen their claws; but we did not succeed in disturbing one. From this point the Rio Uruguay presented to our view a noble volume of water. From the clearness and rapidity of the stream, its appearance was far superior to that of its neighbour the Parana. On the opposite coast, several branches from the latter river entered the Uruguay. As the sun was shining, the two colours of the waters could be seen quite distinct. The geological section presented by the cliffs was interesting. At St. Fe, a stratum with marine remains was seen gradually passing into an estuary deposit. Here we have an alternation of action;—a circumstance no ways improbable in a great bay. A formation of red earthy clay, with nodules of marl, and in every respect identical with that of the Pampas, is covered by a white limestone, containing large extinct oysters, and other marine shells; and over this again, is placed the reddish earthy matter, as in the rest of Banda Oriental.

In the evening we proceeded on our road towards Mercedes on the Rio Negro. At night we asked permission to sleep at an estancia, at which we happened to arrive. It was a very large estate, being ten leagues square, and the owner is one of the greatest landowners in the country. His nephew had charge of it, and with him there was a captain in the army, who the other day ran away from Buenos Ayres. Considering their station, their conversation was rather amusing. They expressed, as was usual, unbounded astonishment at the globe being round, and could scarcely credit that a hole would, if deep enough, come out on the other side. They had, however, heard of a

country where there were six months light and six of darkness, and where the inhabitants were very tall and thin! They were curious about the price and condition of horses and cattle in England. Upon finding out we did not catch our animals with the lazo, they cried out, "Ah then, you use nothing but the bolas:" the idea of an enclosed country was quite novel to them. The captain at last said, he had one question to ask me, which he should be very much obliged if I would answer with all truth. I trembled to think how deeply scientific it would be: it was, "Whether the ladies of Buenos Ayres were not the handsomest in the world." I replied, "Charmingly so." He added, I have one other question: "Do ladies in any other part of the world wear such large combs?" I solemnly assured him they did not. They were absolutely delighted. The captain exclaimed, "Look there! a man who has seen half the world says it is the case; we always thought so, but now we know it." My excellent judgment in beauty procured me a most hospitable reception; the captain forced me to take his bed, and he would sleep on his recado.

21st.—Started at sunrise, and rode slowly during the whole day. The geological nature of this part of the province was different from the rest, and closely resembled that of the Pampas. In consequence, there were immense beds of the thistle, as well as of the cardoon: the whole country, indeed, may be called one great bed. The two sorts grow separate, each plant in company with its own kind. The cardoon is as high as a horse's back, but the Pampas thistle is often higher than the crown of the rider's head. To leave the road for a yard is out of the question; and the road itself is partly, and in some cases entirely, closed. Pasture, of course, there is none; if cattle or horses once enter the bed, they are for the time completely lost. Hence it is very hazardous to attempt to drive cattle at this season of the year; for when jaded enough to face the thistles, they rush among them, and are seen no more. In these districts there are very few estancias, and these few are situated in the

neighbourhood of damp valleys, where fortunately neither of these overwhelming plants can exist. As night came on before we arrived at our journey's end, we slept at a miserable little hovel, inhabited by the poorest people. The extreme, though rather formal courtesy, of our host and hostess, considering their grade of life, was quite delightful.

November 22d.—Arrived at an estancia on the Berquelo belonging to a very hospitable Englishman, to whom I had a letter of introduction from my friend Mr. Lumb. I staid here three days. One morning I rode with my host to the Sierra del Pedro Flaco, about twenty miles up the Rio Negro. Nearly the whole country was covered with good, though coarse grass, which was as high as a horse's belly; yet there were square leagues without a single head of cattle. The province of Banda Oriental, if well stocked, would support an astonishing number of animals; at present the annual export of hides from Monte Video amounts to three hundred thousand; and the home consumption, from waste, is very considerable. The view of the Rio Negro from the Sierra was the most picturesque which I any where saw. The river, broad, deep, and rapid, wound at the foot of a rocky precipitous cliff: a belt of wood followed its course, and the horizon was terminated by the distant undulations of the plain of turf.

When in this neighbourhood I several times heard of the Sierra de las Cuentas; a hill distant many miles to the northward. The name signifies hill of beads. I was assured that vast numbers of little round stones, of various colours, each with a small cylindrical hole, are found there. Formerly the Indians used to collect them, for the purpose of making necklaces and bracelets — a taste, I may observe, which is common to all savage nations, as well as to the most polished. I did not know what to understand from this story, but upon mentioning it at the Cape of Good Hope to Dr. Andrew Smith, he told me that he recollected finding on the south-eastern coast of Africa, about one hundred miles to the eastward of St. John's river, some

quartz crystals with their edges blunted from attrition, and mixed with gravel on the sea-beach. Each crystal was about five lines in diameter, and from an inch to an inch and a half in length. Many of them had a small canal extending from one extremity to the other, perfectly cylindrical, and of a size that readily admitted a coarse thread, or a piece of fine catgut. Their colour was red or dull white. The natives were acquainted with this structure in crystals. I have mentioned these circumstances, because, although no crystallized body is at present known to assume this form, it may lead some future traveller to investigate the real nature of such stones.

While staying at this estancia, I was amused with what I saw and heard of the shepherd dogs of the country.* When riding, it is a common thing to meet a large flock of sheep guarded by one or two dogs, at the distance of some miles from any house or man. I often wondered how so firm a friendship had been established. The method of education consists in separating the puppy, while very young, from the bitch, and in accustoming it to its future companions. An ewe is held three or four times a day for the little thing to suck; and a nest of wool is made for it in the sheep-pen; at no time is it allowed to associate with other dogs, or with the children of the family. The puppy is, moreover, generally castrated; so that, when grown up, it can scarcely have any feelings in common with the rest of its kind. From this education it has no wish to leave the flock, and just as another dog will defend its master, man, so will these, the sheep. It is amusing to observe, when approaching a flock, how the dog immediately advances barking, and the sheep all close in his rear, as if round the oldest ram. These dogs are also easily taught to bring home the flock, at a certain hour in the evening. Their most troublesome fault, when young, is their desire of playing with the sheep; for

* M. D'Orbigny has given nearly a similar account of these dogs, vol. i., p. 175.

in their sport they sometimes gallop their poor subjects most unmercifully.

The shepherd dog comes to the house every day for some meat, and immediately it is given him, he skulks away as if ashamed of himself. On these occasions the house-dogs are very tyrannical, and the least of them will attack and pursue the stranger. The minute, however, the latter has reached the flock, he turns round, and begins to bark, and then all the house-dogs take very quickly to their heels. In a similar manner a whole pack of the hungry wild dogs will scarcely ever (and I was told by some, never) venture to attack a flock guarded even by one of these faithful shepherds. The whole account appears to me a curious instance of the pliability of the affections in the dog race; and yet, whether wild, or however educated, with a mutual feeling of respect or fear for those that are fulfilling their instinct of association. For we can understand on no principle, the wild dogs being driven away by the single one with its flock, except that they consider, from some confused notion, that the one thus associated gains power, as if in company with its own kind. F. Cuvier has observed, that all animals that readily enter into domestication, consider man as a member of their society, and thus fulfil their instinct of association. In the above case the shepherd dogs rank the sheep as their fellow brethren; and the wild dogs, though knowing that the individual sheep are not dogs, but are good to eat, yet partly consent to this view, when seeing them in a flock with a shepherd dog at their head.

One evening a "domidor" (a subduer of horses) came for the purpose of breaking in some colts. I will describe the preparatory steps, for I believe they have not been mentioned by other travellers. A troop of wild young horses is driven into the corral, or large enclosure of stakes, and the door is shut. We will suppose that one man alone has to catch and mount a horse, which as yet had never felt bridle or saddle. I conceive, except by a Gaucho, such a feat would

be utterly impracticable. The Gaucho picks out a full-grown colt; and as the beast rushes round the circus, he throws his lazo so as to catch both the front legs. Instantly the horse rolls over with a heavy shock, and, whilst struggling on the ground, the Gaucho, holding the lazo tight, makes a circle, so as to catch one of the hind legs, just beneath the fetlock, and draws it close to the two front. He then hitches the lazo, so that the three legs are bound together. Then sitting on the horse's neck, he fixes a strong bridle, without a bit, to the lower jaw. This he does by passing a narrow thong through the eye-holes, at the end of the reins, and several times round both jaw and tongue. The two front legs are now tied closely together with a strong leathern thong, fastened by a slip-knot. The lazo, which bound the three together, being then loosed, the horse rises with difficulty. The Gaucho now holding fast the bridle fixed to the lower jaw, leads the horse outside the corral. If a second man is present (otherwise the trouble is much greater) he holds the animal's head, whilst the first puts on the horsecloths and saddle, and girths the whole together. During this operation, the horse, from dread and astonishment at thus being bound round the waist, throws himself, over and over again, on the ground, and, till beaten, is unwilling to rise. At last, when the saddling is finished, the poor animal can hardly breathe from fear, and is white with foam and sweat. The man now prepares to mount, by pressing heavily on the stirrup, so that the horse may not lose its balance; and at the moment he throws his leg over the animal's back he pulls the slip-knot, and the beast is free. Some "domidors" pull the knot while the animal is lying on the ground, and, standing over the saddle, allow it to rise beneath them. The horse, wild with dread, gives a few most violent bounds, and then starts off at full gallop: when quite exhausted, the man, by patience, brings him back to the corral, where reeking hot, and scarcely alive, the poor beast is let free. Those animals which will not gallop away, but obstinately throw

themselves on the ground, are by far the most troublesome. This process is tremendously severe,* but in two or three trials the horse is tamed. It is not, however, for some weeks that the animal is ridden with the iron bit and solid ring; for it must learn to associate the will of its rider with the feel of the rein, before the most powerful bridle can be of any service.

The Gauchos are well known to be perfect riders. The idea of being thrown, let the horse do what it likes, never enters their head. Their criterion of a good rider, is a man who can manage an untamed colt, or who, if his horse falls, alights on his own feet, or can perform other such exploits. I have heard of a man betting that he would throw his horse down twenty times, and that nineteen out of these he would not fall himself. I recollect seeing a Gaucho riding a very stubborn horse, which three times successively reared so high as to fall backwards with great violence. The man judged with uncommon coolness the proper moment for slipping off, not an instant before or after the right time. Directly the horse rose the man jumped on his back, and at last they started at a gallop. The Gaucho never appears to exert any muscular force. I was one day watching a good rider, as we were galloping along at a rapid pace, and thought to myself, "surely if the horse starts, you appear so careless on your seat you must fall." At this moment, a male ostrich sprang from its nest right beneath the horse's nose. The young colt bounded on one side, like a stag; but as for the man, all that

* Animals are so abundant in these countries that humanity and self-interest are not closely united; therefore the former is scarcely known. One day, riding in the Pampas with a very respectable "Estanciero," my horse, being tired, lagged behind. The man often shouted to me to spur him. When I remonstrated that it was a pity, for the horse was quite exhausted, he cried out, "Why not?—never mind—spur him—it is *my* horse." I had then some difficulty in making him comprehend that it was for the horse's sake, and not on his account, that I did not choose to use my spurs. He exclaimed, with a look of great surprise, "Ah Don Carlos que cosa!" It was clear that such an idea had never before entered his head.

could be said, was, that he started and took fright, as part of his horse.

In Chile and Peru more pains are taken with the mouth of the horse than in La Plata, and this is evidently a consequence of the more intricate nature of the country. In Chile a horse is not considered perfectly broken till he can be brought up standing, in the midst of his full speed, on any particular spot,—for instance, on a cloak thrown on the ground: or, again, will charge a wall, and rearing, scrape the surface with his hoofs. I have seen an animal bounding with spirit, yet merely reined by a fore-finger and thumb, taken at full gallop across a courtyard, and then made to wheel round the post of a verandah with great speed, but at so equal a distance, that the rider, with outstretched arm, all the while kept one finger rubbing the post. Then making a demi-volte in the air, with the other arm outstretched in a like manner, he wheeled round, with astonishing force, in an opposite direction.

Such a horse is well broken; and although this at first may appear useless, it is far otherwise. It is only carrying that which is daily necessary into perfection. When a bullock is checked and caught by the lazo, it will sometimes gallop round and round in a circle, and the horse being alarmed at the great strain, if not well broken, will not readily turn like the pivot of a wheel. In consequence many men have been killed; for if the lazo once takes a twist round a man's body, it will instantly, from the power of the two opposed animals, almost cut him in twain. On the same principle the races are managed; the course is only two or three hundred yards long, the desideratum being to have horses that can make a rapid dash. The race-horses are trained not only to stand with their hoofs touching a line, but to draw all four feet together, so as at the first spring to bring into play the full action of the hind quarters. In Chile I was told an anecdote, which I believe was true; and it offers a good illustration of the use of a well-broken animal. A respectable man riding one day met two others, one of

whom was mounted on a horse, which he knew to have been stolen from himself. He challenged them; they answered him by drawing their sabres and giving chase. The man, on his good and fleet beast kept just ahead: as he passed a thick bush he wheeled round it, and brought up his horse to a dead check. The pursuers were obliged to shoot on one side and ahead. Then instantly dashing on, right behind them, he buried his knife in the back of one, wounded the other, recovered his horse from the dying robber, and rode home. For these feats of horsemanship two things are necessary: a most severe bit, like the Mameluke, the power of which though seldom used, the horse knows full well; and large blunt spurs, that can be applied either as a mere touch, or as an instrument of extreme pain. I conceive that with English spurs, the slightest touch of which pricks the skin, it would be impossible to break in a horse after the South-American fashion.

At an estancia near Las Vacas, large numbers of mares, are weekly slaughtered for the sake of their hides, although worth only five paper dollars, or about half-a-crown apiece. It seems at first strange that it can answer to kill mares for such a trifle; but as it is thought ridiculous in this country, ever to break in, or to ride a mare, they are of no value, except for breeding. The only thing for which I ever saw mares used was to tread out wheat from the ear; for which purpose they were driven round a circular enclosure, where the wheat-sheaves were strewed. The man employed for slaughtering the mares, happened to be celebrated for his dexterity with the lazo. Standing at the distance of twelve yards from the mouth of the corral, he has laid a wager that he would catch by the legs every animal, without missing one, as it rushed past him. There was another man who said he would enter the corral on foot, catch a mare, fasten her front legs together, drive her out, throw her down, kill, skin, and stake the hide for drying (which latter is a tedious job); and he engaged that he would perform this whole operation on twenty-two animals in one day. Or, he would

kill and take the skin off fifty in the same time. This would have been a prodigious task, for it is considered a good day's work to skin and stake the hides of fifteen or sixteen animals.

November 26th.—I set out on my return in a direct line for Monte Video. Having heard of some giant's bones at a neighbouring farm-house on the Sarandis, a small stream entering the Rio Negro, I rode there accompanied by my host, and purchased for the value of eighteen pence, the head of an animal equalling in size that of the hippopotamus. Mr. Owen in a paper read before the Geological Society,* has called this very extraordinary animal, Toxodon, from the curvature of its teeth. The following notice is taken from the proceedings of that society: Mr. Owen says, judging from the portion of the skeleton preserved, the Toxodon, as far as dental characters have weight, must be referred to the rodent order. But from that order it deviates in the relative position of its supernumerary incisors, in the number and direction of the curvature of its molars, and in some other respects. It again deviates, in several parts of its structure which Mr. Owen enumerated, both from the *Rodentia*, and the existing *Pachydermata*, and it manifests an affinity to the *Dinotherium* and the *Cetaceous* order. Mr. Owen, however, observed, that "the development of the nasal cavity and the presence of frontal sinuses, renders it extremely improbable that the habits of the *Toxodon* were so exclusively aquatic as would result from the total absence of hinder extremities; and concludes, therefore, that it was a quadruped, and not a Cetacean; and that it manifested an additional step in the gradation of mammiferous forms leading from the *Rodentia*, through the *Pachydermata* to the *Cetacea;* a gradation of which the water-hog of South America (*Hydrochœrus capybara*) already indicates the commencement amongst existing *Rodentia*, of which order it is interesting to observe this species is the largest, while at

* Read, April 19th, 1837. A detailed account will appear in the first part of the zoology of the voyage of the Beagle.

the same time it is peculiar to the continent in which the remains of the gigantic *Toxodon* were discovered."

The people at the farm-house told me that the remains were exposed, by a flood having washed down part of a bank of earth. When found, the head was quite perfect; but the boys knocked the teeth out with stones, and then set up the head as a mark to throw at. By a most fortunate chance, I found a perfect tooth, which exactly fits one of the sockets in this skull, embedded by itself on the banks of the Rio Tercero, at the distance of about 180 miles from this place. Near the Toxodon I found the fragments of the head of an animal, rather larger than the horse, which has some points of resemblance with the Toxodon, and others perhaps with the Edentata. The head of this animal, as well as that of the Toxodon, and especially the former, appear so fresh, that it is difficult to believe they have lain buried for ages under ground. The bone contains so much animal matter, that when heated in the flame of a spirit-lamp, it not only exhales a very strong animal odour, but likewise burns with a slight flame.*

At the distance of a few leagues I visited a place where the remains of another great animal, associated with large pieces of armadillo-like covering, had been found. Similar pieces were likewise lying in the bed of the stream, close to the spot where the skeleton of the Toxodon had been exposed. These portions are dissimilar from those mentioned at Bahia Blanca. It is a most interesting fact thus to discover, that more than one gigantic animal in former ages was protected by a coat of mail,† very similar to the kind now

* I must express my obligation to Mr. Keane, at whose house I was staying on the Berquelo, and to Mr. Lumb at Buenos Ayres, for without their assistance, these valuable remains would never have reached England.

† I may here just mention, that I saw in the possession of a clergyman near Monte Video, the terminal portion of a tail, which precisely resembled, but on a gigantic scale, that of the common armadillo. The fragment was 17 inches long, 11½ in circumference at the upper end, and 8½ at the *extreme* point. As we do not know what proportion the tail

found on the numerous species of armadillo, and exclusively confined to that South-American genus.

By the middle of the day on the 28th we arrived at Monte Video, having been two days and a half on the road. The country for the whole way was of a very uniform character, some parts being rather more rocky and hilly than near the Plata. Not far from Monte Video we passed through the village of Las Pietras, so named from some large rounded masses of syenite. Its appearance was rather pretty. In this country, a few fig-trees around the houses, and a site elevated a hundred feet above the general level, ought always to be called picturesque.

During the last six months, I have had an opportunity of seeing a little of the character of the inhabitants of these provinces. The Gauchos, or countrymen, are very superior to those who reside in the towns. The Gaucho is invariably most obliging, polite, and hospitable. I did not meet even with one instance of rudeness or inhospitality. He is modest, both respecting himself and country, at the same time being a spirited, bold fellow. On the other hand, there is much blood shed, and many robberies committed. The constant presence of the knife is the chief cause of the former. It is lamentable to hear how many lives are lost in trifling quarrels. In fighting, each party tries to mark the face of his adversary, by slashing his nose or eyes; as is often attested by deep and horrid-looking scars. Robberies are a natural consequence of universal gambling, much drinking, and extreme indolence. At Mercedes, I asked two men why they did not work. One gravely said the days were too long, the other that he was too poor. The number of horses, and the profusion of food, are the destruction of all industry. Moreover, there are so many feast-days; and then nothing can succeed without it is begun

bore to the body of the animal, we cannot compare it with that of any living species. But at the same time we may conjecture that, in all probability, this extinct monster was from six to ten feet long.

when the moon is on the increase; so that half the month is lost from these two causes.

Police and justice are quite inefficient. If a man who is poor, commits murder, and is taken, he will be imprisoned, and perhaps even shot; but if he is rich and has friends, he may rely on it, no very severe consequence will ensue. It is curious that the most respectable people in the country invariably assist a murderer to escape. They seem to think the individual sins against the governing powers and not against the state. A traveller has no protection besides his fire-arms: and the constant habit of carrying them, is the main check to a more frequent occurrence of robbery.

The character of the higher and more educated classes, who reside in the towns, partakes, but perhaps in a lesser degree, of the good parts of the Gaucho, but is I fear stained by many vices of which he is free. Sensuality, mockery of all religion, and the grossest corruption, are far from uncommon. Nearly every public officer can be bribed. The head man in the post-office sold forged government franks. The governor and prime minister openly combined to plunder the state. Justice, where gold came into play, was hardly expected by any one. I knew an Englishman, who went to the chief-justice (he told me that not understanding the ways of the place, he trembled as he entered the room), and said, "Sir, I have come to offer you 200 dollars (value about five pounds sterling) if you will arrest before a certain time a man who has cheated me. I know it is against the law, but my lawyer (naming him) recommended me to take this step." The chief justice smiled acquiescence, thanked him, and the man before night was safe in prison. With this entire want of principle in many of the leading men, with the country full of ill-paid turbulent officers, the people yet hope that a democratic form of government can succeed!

On first entering society in these countries, two or three features strike one as particularly remarkable. The polite and dignified manners pervading every grade of life; the excellent

taste displayed by the women in their dresses; and the equality amongst all ranks. At the Rio Colorado some men who kept the humblest shops, used to dine with General Rosas. A son of a major at Bahia Blanca gained his livelihood by making paper cigars, and he wished to accompany me, as guide or servant, to Buenos Ayres, but his father objected on the score of the danger alone. Many officers in the army can neither read nor write, yet all meet in society as equals. In Entre Rios, the Sala consisted of only six representatives. One of them kept a common shop, and evidently was not degraded by the office. All this is what would be expected in a new country; nevertheless, the absence of gentlemen by profession appears to an Englishman something strange.

When speaking of these countries, the manner in which they have been brought up by their unnatural parent, Spain, should always be borne in mind. On the whole, perhaps, more credit is due for what has been done, than blame for that which may be deficient. It is impossible to doubt but that the extreme liberalism of these countries, must ultimately lead to good results. The very general toleration of foreign religions, the regard paid to the means of education, the freedom of the press, the facilities offered to all foreigners, and especially, as I am bound to add, to every one professing the humblest pretensions to science, should be recollected with gratitude, by those who have visited Spanish South America.*

* I cannot conclude without adding my testimony to the spirit and accuracy of "Head's Rough Notes." I do not think the picture is at all more exaggerated than every good one must be—that is, by taking the strong examples, and neglecting those of lesser interest.

CHAPTER IX.

Rio Plata—Flocks of butterflies—Beetles alive in the sea—Aeronaut spiders—Pelagic animals—Phosphorescence of sea—Port Desire—Spanish settlements—Zoology—Guanaco—Excursion to head of harbour—Indian grave—Port St. Julian—Geology of Patagonia, successive terraces, transport of pebbles—Fossil gigantic llama—Types of organization constant—Change in zoology of America—Causes of extinction.

PATAGONIA.

DECEMBER 6TH, 1833.—The Beagle sailed from the Rio Plata, never again to enter its muddy stream. Our course was directed to Port Desire, on the coast of Patagonia. Before proceeding any further, I will here put together a few observations made at sea.

Several times when the ship has been some miles off the mouth of the Plata, and at other times when off the shores of Northern Patagonia, we have been surrounded by insects. One evening, when we were about ten miles from the Bay of San Blas, vast numbers of butterflies, in bands or flocks of countless myriads, extended as far as the eye could range. Even by the aid of a glass it was not possible to see a space free from butterflies. The seamen cried out "it was snowing butterflies," and such in fact was the appearance. More species than one were present, but the main part belonged to a kind very similar to, but not identical with, the common English *Colias edusa*.* Some moths and hymenoptera accompanied the butterflies; and a fine Calosoma flew on board. Other instances are known of this beetle having been caught far out at sea; and this is the more remarkable, as the greater number of the Carabidæ seldom or never take wing. The day had been

* I am indebted to Mr. Waterhouse for naming these and other insects.

fine and calm, and the one previous to it equally so, with light and variable airs. Hence we cannot suppose that the insects were blown off the land, but we must conclude that they voluntarily took flight. The great bands of the Colias seem at first to afford an instance like those on record of the migrations of *Vanessa cardui;** but the presence of other insects makes the case distinct, and not so easily intelligible. Before sunset, a strong breeze sprung up from the north, and this must have been the cause of tens of thousands of the butterflies and other insects having perished.

On another occasion, when seventeen miles off Cape Corrientes, I had a net overboard to catch pelagic animals. Upon drawing it up, to my surprise I found a considerable number of beetles in it, and although in the open sea, they did not appear much injured by the salt water. I lost some of the specimens, but those which I preserved, belonged to the genera, colymbetes, hydroporus, hydrobius (two species), notaphus, cynucus, adimonia, and scarabæus. At first, I thought that these insects had been blown from the shore; but upon reflecting that out of the eight species, four were aquatic, and two others partly so in their habits, it appeared to me most probable that they were floated into the sea, by a small stream which drains a lake near Cape Corrientes. On any supposition, it is an interesting circumstance to find insects, quite alive, swimming in the open ocean, seventeen miles from the nearest point of land. There are several accounts of insects having been blown off the Patagonian shore. Captain Cook observed it, as did more lately Captain King in the Adventure. The cause probably is due to the want of shelter, both of trees and hills, so that an insect on the wing with an off-shore breeze, would be very apt to be blown out to sea. The most remarkable instance I ever knew of an insect being caught far from the land, was that of a large grasshopper (*Acrydium*), which flew on board, when the

* Lyell's Geology, vol. iii., p. 63.

Beagle was to windward of the Cape de Verd Islands, and when the nearest point of land, not directly opposed to the trade-wind, was Cape Blanco on the coast of Africa, 370 miles distant.*

On several occasions, when the vessel has been within the mouth of the Plata, the rigging has been coated with the web of the Gossamer Spider. One day (November 1st, 1832) I paid particular attention to the phenomenon. The weather had been fine and clear, and in the morning the air was full of patches of the flocculent web, as on an autumnal day in England. The ship was sixty miles distant from the land, in the direction of a steady though light breeze. Vast numbers of a small spider, about one-tenth of an inch in length, and of a dusky red colour were attached to the webs. There must have been, I should suppose, some thousands on the ship. The little spider when first coming in contact with the rigging, was always seated on a single thread, and not on the flocculent mass. This latter seems merely to be produced by the entanglement of the single threads. The spiders were all of one species, but of both sexes, together with young ones. These latter were distinguished by their smaller size, and more dusky colour. I will not give the description of this spider, but merely state that it does not appear to me to be included in any of Latreille's genera. The little aeronaut as soon as it arrived on board, was very active, running about; sometimes letting itself fall, and then reascending the same thread; sometimes employing itself in making a small and very irregular mesh in the corners between the ropes. It could run with facility on the surface of water. When disturbed it lifted up its front legs, in the attitude of attention. On its first arrival it appeared very thirsty, and with exserted maxillæ drank eagerly of the fluid; this same circumstance

* The flies which frequently accompany a ship for some days on its passage from harbour to harbour, wandering from the vessel, are soon lost, and all disappear.

has been observed by Strack: may it not be in consequence of the little insect having passed through a dry and rarefied atmosphere? Its stock of web seemed inexhaustible. While watching some that were suspended by a single thread, I several times observed that the slightest breath of air bore them away out of sight, in a horizontal line. On another occasion (25th) under similar circumstances, I repeatedly observed the same kind of small spider, either when placed, or having crawled, on some little eminence, elevate its abdomen, send forth a thread, and then sail away in a lateral course, but with a rapidity which was quite unaccountable. I thought I could perceive that the spider before performing the above preparatory steps, connected its legs together with the most delicate threads, but I am not sure, whether this observation is correct.

One day, at St. Fe, I had a better opportunity of observing some similar facts. A spider which was about three-tenths of an inch in length, and which in its general appearance resembled a Citigrade (therefore quite different from the gossamer), while standing on the summit of a post, darted forth four or five threads from its spinners. These glittering in the sunshine, might be compared to rays of light; they were not, however, straight, but in undulations like a film of silk blown by the wind. They were more than a yard in length, and diverged in an ascending direction from the orifices. The spider then suddenly let go its hold, and was quickly borne out of sight. The day was hot and apparently quite calm; yet under such circumstances the atmosphere can never be so tranquil, as not to affect a vane so delicate as the thread of a spider's web. If during a warm day we look either at the shadow of any object cast on a bank, or over a level plain at a distant landmark, the effect of an ascending current of heated air will almost always be evident. And this probably would be sufficient to carry with it so light an object as the little spider on its thread. The circumstance of spiders of the same species but of different sexes and ages, being found on several occasions at the distance of many leagues from the

land, attached in vast numbers to the lines, proves that they are the manufacturers of the mesh, and that the habit of sailing through the air, is probably as characteristic of some tribe, as that of diving is of the Argyroneta. We may then reject Latreille's supposition, that the gossamer owes its origin to the webs of the young of several genera, as Epeira or Thomisa: although, as we have seen that the young of other spiders do possess the power of performing aerial voyages.*

During our different passages south of the Plata, I often towed astern a net made of bunting, and thus caught many curious animals. The structure of the Beroe (a kind of jelly fish) is most extraordinary, with its rows of vibratory ciliæ, and complicated though irregular system of circulation. Of Crustacea, there were many strange and undescribed genera. One, which in some respects is allied to the Notopods (or those crabs which have their posterior legs placed almost on their backs, for the purpose of adhering to the under side of ledges), is very remarkable from the structure of its hind pair of legs. The penultimate joint, instead of being terminated by a simple claw, ends in three bristle-like appendages of dissimilar lengths,—the longest equalling that of the entire leg. These claws are very thin, and are serrated with teeth of an excessive fineness, which are directed towards the base. The curved extremities are flattened, and

* I was not at the time aware of M. Virey's very curious observations, (Bulletin des Sciences Natur., tom. xix., p. 130) which seem to prove that small spiders, in an atmosphere perfectly tranquil, and without the aid of any web, have the power of darting through the air. M. Virey, believes that by means of a rapid vibration of their feet, they *walk the air*. Although in his case, the conclusion seems almost inevitable, yet in the one I have described, we must suppose that the several threads which were sent forth, served as sails for the atmospheric currents to act on. After reading M. Virey's account, it appears to me far from improbable, that the little aeronaut actually did unite, as was suspected, its feet together by some fine lines; thus forming artificial wings. I regret I did not determine this point with accuracy; for it would be a curious fact, that a spider should thus be able to take flight by the aid of temporary wings.

on this part five most minute cups are placed, which seem to act in the same manner as the suckers on the arms of the cuttle-fish. As the animal lives in the open sea, and probably wants a place of rest, I suppose this beautiful structure is adapted to take hold of the globular bodies of the Medusæ, and other floating marine animals.

In deep water, far from the land, the number of living creatures is extremely small: south of the latitude 35°, I never succeeded in catching any thing besides some beroe, and a few species of minute crustacea belonging to the Entomostraca. In shoaler water, at the distance of a few miles from the coast, very many kinds of crustacea and some other animals were numerous, but only during the night. Between latitudes 56° and 57° south of Cape Horn the net was put astern several times; it never, however, brought up any thing besides a few of two extremely minute species of Entomostraca. Yet whales and seals, petrels and albatross, are exceedingly abundant throughout this part of the ocean. It has always been a source of mystery to me, on what the latter, which live far from the shore, can subsist. I presume the albatross, like the condor, is able to fast long; and that one good feast on the carcass of a putrid whale lasts for a long siege of hunger. It does not lessen the difficulty to say, they feed on fish; for on what can the fish feed? It often occurred to me, when observing how the waters of the central and intertropical parts of the Atlantic,* swarmed with Pteropoda, Crustacea, and Radiata, and with their devourers the flying-fish, and again with *their* devourers the bonitos and albicores, that the lowest of these pelagic animals perhaps possess the power of decomposing carbonic acid gas, like the members of the vegetable kingdom.

While sailing in these latitudes on one very dark night,

* From my experience, which has been but little, I should say that the Atlantic was far more prolific than the Pacific, at least, than in that immense open area, between the west coast of America and the extreme eastern isles of Polynesia.

the sea presented a wonderful and most beautiful spectacle. There was a fresh breeze, and every part of the surface, which during the day is seen as foam, now glowed with a pale light. The vessel drove before her bows two billows of liquid phosphorus, and in her wake she was followed by a milky train. As far as the eye reached, the crest of every wave was bright, and the sky above the horizon, from the reflected glare of these livid flames, was not so utterly obscure, as over the rest of the heavens.

As we proceed further southward, the sea is seldom phosphorescent; and off Cape Horn, I do not recollect more than once having seen it so, and then it was far from being brilliant. This circumstance probably has a close connexion with the scarcity of organic beings in that part of the ocean. After the elaborate paper* by Ehrenberg, on the phosphorescence of the sea, it is almost superfluous on my part to make any observations on the subject. I may however add, that the same torn and irregular particles of gelatinous matter, described by Ehrenberg, seem in the southern as well as in the northern hemisphere, to be the common cause of this phenomenon. The particles were so minute as easily to pass through fine gauze; yet many were distinctly visible by the naked eye. The water when placed in a tumbler and agitated gave out sparks, but a small portion in a watch-glass, scarcely ever was luminous. Ehrenberg states, that these particles all retain a certain degree of irritability. My observations, some of which were made directly after taking up the water, would give a different result. I may also mention, that having used the net during one night I allowed it to become partially dry, and having occasion twelve hours afterwards, to employ it again, I found the whole surface sparkled as brightly as when first taken out of the water. It does not appear probable in this case, that the particles could have remained so long alive. I remark

* An abstract is given in No. IV. of the Magazine of Zoology and Botany.

also in my notes, that having kept a Medusa of the genus Dianæa, till it was dead, the water in which it was placed became luminous. When the waves scintillate with bright green sparks, I believe it is generally owing to minute crustacea. But there can be no doubt that very many other pelagic animals, when alive, are phosphorescent.

On two occasions I have observed the sea luminous at considerable depths beneath the surface. Near the mouth of the Plata some circular and oval patches, from two to four yards in diameter, and with defined outlines, shone with a steady, but pale light; while the surrounding water only gave out a few sparks. The appearance resembled the reflection of the moon, or some luminous body; for the edges were sinuous from the undulation of the surface. The ship, which drew thirteen feet water, passed over, without disturbing, these patches. Therefore we must suppose that some animals were congregated together at a greater depth than the bottom of the vessel.

Near Fernando Noronha the sea gave out light in flashes. The appearance was very similar to that which might be expected from a large fish moving rapidly through a luminous fluid. To this cause the sailors attributed it; at the time, however, I entertained some doubts, on account of the frequency and rapidity of the flashes. With respect to any general observations, I have already stated that the display is very much more common in warm than in cold countries. I have sometimes imagined that a disturbed electrical condition of the atmosphere was most favourable to its production. Certainly I think the sea is most luminous after a few days of more calm weather than ordinary, during which time it has swarmed with various animals. Observing that the water charged with gelatinous particles is in an impure state, and that the luminous appearance in all common cases is produced by the agitation of the fluid in contact with the atmosphere, I have always been inclined to consider that the phosphorescence was the result of the decomposition of the organic particles, by which process (one is tempted

almost to call it a kind of respiration) the ocean becomes purified.

DECEMBER 23D.—We arrived at Port Desire, situated in lat. 47°, on the coast of Patagonia. The creek runs for about twenty miles inland, with an irregular width. The Beagle anchored a few miles within the entrance in front of the ruins of an old Spanish settlement.

The same evening I went on shore. The first landing in any new country is very interesting, and especially when, as in this case, the whole aspect bears the stamp of a marked and individual character. At the height of between two and three hundred feet, above some masses of porphyry, a wide plain extends, which is truly characteristic of Patagonia. The surface is quite level, and is composed of well-rounded shingle mixed with a whitish earth. Here and there scattered tufts of brown wiry grass are supported, and still more rarely some low thorny bushes. The weather is dry and pleasant, for the fine blue sky is but seldom obscured. When standing in the middle of one of these desert plains, the view on one side is generally bounded by the escarpment of another plain, rather higher, but equally level and desolate; and on the other side it becomes indistinct from the trembling mirage which seems to rise from the heated surface.

The plains are traversed by many broad, flat-bottomed valleys, and in these the bushes grow rather more abundantly. The present drainage of the country is quite insufficient to excavate such large channels. In some of the valleys ancient stunted trees, growing in the very centre of the dry watercourse, seem as if placed to prove how long a time had elapsed, since any flood had passed that way. We have evidence, from shells lying on the surface, that the plains of gravel have been elevated within a recent epoch above the level of the sea; and we must look to that period for the excavation of the valleys by the slowly-retiring waters. From the dryness of the climate, a man may walk for days together over these plains without finding a single drop of water. Even at the base of the porphyry hills, there

are only a few small wells containing but little water, and that rather saline and half putrid.

In such a country the fate of the Spanish settlement was soon decided; the dryness of the climate during the greater part of the year, and the occasional hostile attacks of the wandering Indians, compelled the colonists to desert their half-finished buildings. The style, however, in which they were commenced, showed the strong and liberal hand of Spain in the old time. The end of all the attempts to colonize this side of America south of 41°, have been miserable. At Port Famine, the name expresses the lingering and extreme sufferings of several hundred wretched people, of whom one alone survived to relate their misfortunes. At St. Joseph's bay, on the coast of Patagonia, a small settlement was made; but during one Sunday the Indians made an attack and massacred the whole party, excepting two men, who were led captive many years among the wandering tribes. At the Rio Negro I conversed with one of these men, now in extreme old age.

The zoology of Patagonia is as limited as its Flora.* On the arid plains a few black beetles (Heteromera) might be seen slowly crawling about, and occasionally a lizard darting from side to side. Of birds we have three carrion hawks, and in the valleys a few finches and insect feeders. The *Ibis malanops* (a species said to be found in central Africa) is not uncommon on the most desert parts. In the stomachs of these birds I found grasshoppers, cicadæ, small lizards, and even scorpions.† At one time of the year they go in flocks, at another in pairs: their cry is very loud and singular, and resembles the neighing of the guanaco.

* I found here a species of cactus, described by Professor Henslow under the name of *Opuntia Darwinii* (Magazine of Zoology and Botany, vol. i., p. 466), which was remarkable by the irritability manifested by the stamens, when I inserted in the flower either a piece of stick, or the end of my finger. The segments of the periant also closed on the pistil, but more slowly than the stamens.

† These insects were not uncommon beneath stones. I found one cannibal scorpion quietly devouring another.

I will here give an account of this latter animal, which is very common, and is the characteristic quadruped of the plains of Patagonia. The Guanaco, which by some naturalists is considered as the same animal with the Llama, but in its wild state, is the South American representative of the camel of the East. In size it may be compared to an ass, mounted on taller legs, and with a very long neck. The guanaco abounds over the whole of the temperate parts of South America, from the wooded islands of Tierra del Fuego, through Patagonia, the hilly parts of La Plata, Chile, even to the Cordillera of Peru. Although preferring an elevated site, it yields in this respect to its near relative the Vicuna. On the plains of Southern Patagonia, we saw them in greater numbers than in any other part. Generally they go in small herds, from half a dozen to thirty together; but on the banks of the St. Cruz we saw one herd which must have contained at least five hundred. On the northern shores of the Strait of Magellan they are also very numerous.

Generally the guanacoes are wild and extremely wary. Mr. Stokes told me, that he one day saw through a glass a herd of these beasts, which evidently had been frightened, running away at full speed, although their distance was so great that they could not be distinguished by the naked eye. The sportsman frequently receives the first intimation of their presence, by hearing, from a long distance, the peculiar shrill neighing note of alarm. If he then looks attentively, he will perhaps see the herd standing in a line on the side of some distant hill. On approaching them, a few more squeals are given, and then off they set at an apparently slow, but really quick canter, along some narrow beaten track to a neighbouring hill. If, however, by chance he should abruptly meet a single animal, or several together, they will generally stand motionless, and intently gaze at him; then perhaps move on a few yards, turn round, and look again. What is the cause of this difference in their shiness? Do they mistake a man in the distance for their chief enemy the puma? Or does curiosity overcome their timidity? That they are curious is certain; for if a person lies on the ground, and

plays strange antics, such as throwing up his feet in the air, they will almost always approach by degrees to reconnoitre him. It was an artifice that was repeatedly practised by our sportsmen with success, and it had moreover the advantage of allowing several shots to be fired, which were all taken as parts of the performance. On the mountains of Tierra del Fuego, and in other places, I have more than once seen a guanaco, on being approached, not only neigh and squeal, but prance and leap about in the most ridiculous manner, apparently in defiance as a challenge. These animals are very easily domesticated, and I have seen some thus kept near the houses, although at large on their native plains. They are in this state very bold, and readily attack a man, by striking him from behind with both knees. It is asserted, that the motive for these attacks is jealousy on account of their females. The wild guanacoes, however, have no idea of defence; even a single dog will secure one of these large animals, till the huntsman can come up. In many of their habits they are like sheep in a flock. Thus when they see men approaching in several directions on horseback, they soon became bewildered, and know not which way to run. This greatly facilitates the Indian method of hunting, for they are thus easily driven to a central point, and are encompassed.

The guanacoes readily take to the water: several times at Port Valdes they were seen swimming from island to island. Byron, in his voyage, says he saw them drinking salt water. Some of our officers likewise saw a herd apparently drinking the briny fluid from a salina near Cape Blanco. I imagine in several parts of the country, if they do not drink salt water, they drink none at all. In the middle of the day, they frequently roll in the dust, in saucer-shaped hollows. The males fight together; two one day passed quite close to me, squealing and trying to bite each other; and several were shot with their hides deeply scored. Herds sometimes appear to set out on exploring-parties: at Bahia Blanca, where, within thirty miles of the coast, these animals are extremely unfrequent, I one day saw the tracks of thirty or forty, which had come in a direct line

to a muddy salt-water creek. They then must have perceived that they were approaching the sea, for they had wheeled with the regularity of cavalry, and had returned back in as straight a line as they had advanced. The guanacoes have one singular habit, which is to me quite inexplicable; namely, that on successive days they drop their dung in the same defined heap. I saw one of these heaps which was eight feet in diameter, and necessarily was composed of a large quantity. Frezier remarks on this habit as common to the guanaco as well as to the llama;* he says it is very useful to the Indians, who use the dung for fuel, and are thus saved the trouble of collecting it.

The guanacoes appear to have favourite spots for dying in. On the banks of the St. Cruz, the ground was actually white with bones, in certain circumscribed spaces, which were generally bushy and all near the river. On one such spot I counted between ten and twenty heads. I particularly examined the bones; they did not appear, as some scattered ones which I had seen, gnawed or broken, as if dragged together by beasts of prey. The animals in most cases, must have crawled, before dying, beneath and amongst the bushes. Mr. Bynoe informs me that during the last voyage, he observed the same circumstance on the banks of the Rio Gallegos. I do not at all understand the reason of this, but I may observe, that the wounded guanacoes at the St. Cruz, invariably walked towards the river. At St. Jago in the Cape de Verd islands I remember having seen in a retired ravine a corner under a cliff, where numerous goats' bones were collected: we at the time exclaimed, that it was the burial-ground of all the goats in the island. I mention these trifling circumstances, because in certain cases they might explain the occurrence of a number of uninjured bones in a cave, or buried under alluvial accumulations; and likewise the cause, why certain mammalia are more commonly embedded than others in sedimentary deposits. Any great

* D'Orbigny says (vol. ii., p. 69) that all the species of the genus have this habit.

flood of the St. Cruz, would wash down many bones of the guanaco, but probably not a single one of the puma, ostrich, or fox. I may also observe, that almost every kind of waterfowl when wounded takes to the shore to die; so that the remains of birds, from this cause alone and independently of other reasons, would but rarely be preserved in a fossil state.

One day the yawl was sent under the command of Mr. Chaffers with three days' provisions to survey the upper part of the harbour. In the morning we searched for some watering-places, mentioned in an old Spanish chart. We found one creek, at the head of which there was a trickling rill (the first we had seen) of brackish water. Here the tide compelled us to wait several hours; and in the interval I walked some miles into the interior. The plain as usual, consisted of gravel, mingled with soil resembling chalk in appearance, but very different from it in nature. From the softness of these materials it was worn into many gullies. There was not a tree, and excepting the guanaco, which stood on the hill-top a watchful sentinel over its herd, scarcely an animal or a bird. All was stillness and desolation. One reflected how many ages the plain had thus lasted, and how many more it was doomed thus to continue. Yet in passing over these scenes, without one bright object near, an ill-defined but strong sense of pleasure is vividly excited.

In the evening we sailed a few miles further up, and then pitched the tents for the night. By the middle of the next day, the yawl was aground, and from the shoalness of the water could not proceed any higher. The water being found partly fresh Mr. Chaffers took the dingey, and went up two or three miles further, where she also grounded, but in a fresh-water river. The water was muddy, and though the stream was most insignificant in size, it would be difficult to account for its source, except from the melting snow on the the Cordillera. At the spot where we bivouacked, we were surrounded by bold cliffs and steep pinnacles of porphyry. I do not think I ever saw a spot, which appeared more

secluded from the rest of the world, than this rocky crevice in the wide plain.

The second day after our return to the anchorage, a party of officers and myself went to ransack an old Indian grave, which I had found on the summit of a neighbouring hill. Two immense stones, each probably weighing at least a couple of tons, had been placed in front of a ledge of rock, about six feet high. At the bottom of the grave on the hard rock, there was a layer of earth about a foot deep, which must have been brought up from the plain below. Above it a pavement of flat stones was placed, on which others were piled, so as to fill up the space between the ledge and the two great blocks. To complete the grave, the Indians had contrived to detach from the same ledge a huge fragment, and to throw it over the pile so as to rest on the two blocks. We undermined the grave on both sides, but could not find any relics, or even bones. The latter probably had decayed long since (in which case the grave must have been of extreme antiquity), for I found in another place some smaller heaps, beneath which a very few crumbling fragments could yet be distinguished, as having belonged to a man. Falconer states, that where an Indian dies he is buried, but that subsequently his bones are carefully taken up and carried, let the distance be ever so great, to be deposited near the sea-coast. This custom, I think, may be accounted for, by recollecting that before the introduction of horses, these Indians must have led nearly the same life as the Fuegians, and therefore generally resided in the neighbourhood of the sea. The common prejudice of lying where one's ancestors have lain, would make the now roaming Indians bring the less perishable part of their dead to their ancient burial-grounds.

January 9th, 1834.—Before it was dark the Beagle anchored in the fine spacious harbour of Port St. Julian, situated about one hundred and ten miles to the south of Port Desire. We remained here eight days. The country is nearly similar to that of Port Desire, but, perhaps, rather more sterile. One day a party accompanied Captain Fitz-

Roy on a long walk round the head of the harbour. We were eleven hours without tasting any water, and some of the party were quite exhausted. From the summit of a hill (since well named Thirsty Hill) a fine lake was spied, and two of the party proceeded with concerted signals to show whether it was fresh water. What was our disappointment to find a snow-white expanse of salt, crystallized in great cubes! We attributed our extreme thirst to the dryness of the atmosphere; but whatever the cause might be, we were exceedingly glad late in the evening to get back to the boats. Although we could nowhere find, during our whole visit, a single drop of fresh water, yet some must exist; for by an odd chance I found on the surface of the salt water, near the head of the bay, a Colymbetes not quite dead, which in all probability had lived in some not far distant pool. Three other kinds of insects,—a Cincindela, like *hybrida*, Cymindis, and a Harpalus, which all live on muddy flats occasionally overflowed by the sea, and one other beetle found dead on the plain,—completes the list of coleoptera. A good-sized fly (Tabanus) was extremely numerous, and tormented us by its painful bite. The common horsefly, which is so troublesome in the shady lanes of England, belongs to this genus. We here have the puzzle, that so frequently occurs in the case of musquitoes; on the blood of what animals do these insects commonly feed? The guanaco is nearly the only warmblooded quadruped, and they are present in numbers quite inconsiderable, compared to the multitude of flies.

The foundation of porphyry is not here present, as it was at Port Desire, and in consequence the tertiary deposits are arranged with greater regularity. Five successive plains of different altitudes are very distinct. The lower one is a mere fringe nearly on a level with the sea, but the upper one is elevated 950 feet. This latter is represented in this neighbourhood only by a few truncate conical hills, of exactly the same height. It was very interesting to stand on one of these flat patches of gravel, and viewing the wide surrounding country, to speculate on the enormous quantity of matter which must

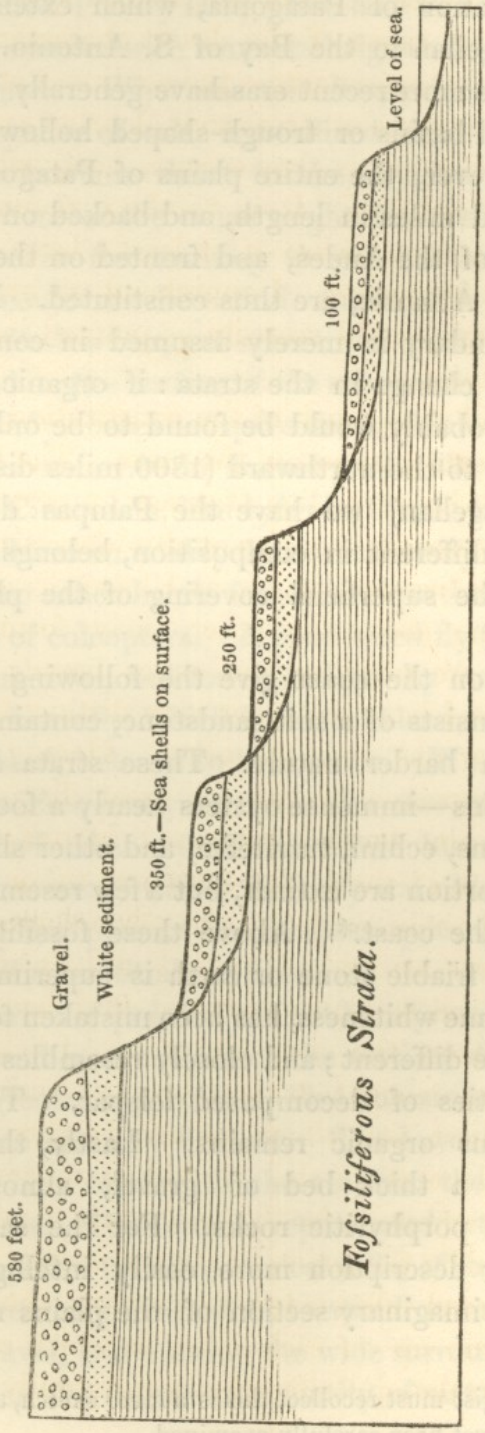
have been removed, thus to leave these mere points, as meaures of the former table-land.

I will now give a brief sketch of the geology of the grand tertiary formation of Patagonia, which extends from the Strait of Magellan to the Bay of S. Antonio. In Europe, deposits of the more recent eras have generally been accumulated in small basins or trough-shaped hollows. In South America, however, the entire plains of Patagonia extending seven hundred miles in length, and backed on the one hand by the chain of the Andes, and fronted on the other by the shores of the Atlantic, are thus constituted. Moreover the northern boundary is merely assumed in consequence of a mineralogical change in the strata: if organic remains were present, it probably would be found to be only an artificial limit. Again to the northward (1300 miles distant from the Strait of Magellan) we have the Pampas deposit, which though very different in composition, belongs to the same epoch with the superficial covering of the plains of Patagonia.

The cliffs on the coast give the following section: The lower part consists of a soft sandstone, containing large concretions of a harder nature. These strata contain many organic remains—immense oysters nearly a foot in diameter, curious pectens, echini, turritellæ, and other shells, of which the greater portion are extinct, but a few resemble those now existing on the coast.* Above these fossiliferous beds, a mass of soft friable stone or earth is superimposed, which, from its extreme whiteness, has been mistaken for chalk. It is, however, quite different; and closely resembles the less argillaceous varieties of decomposed felspar. This substance never contains organic remains. Lastly, the cliff is surmounted by a thick bed of gravel, almost exclusively derived from porphyritic rocks. For the sake of making the following description more easily intelligible, I have subjoined an imaginary section of the plains near the coast.

* The geologist must recollect this is a mere sketch, and that the fossil shells have not yet been carefully examined.

It must be observed, that the width of each plain is in nature *very much* greater in proportion to the height, than here represented.



The whole series is horizontally stratified, and I do not recollect ever seeing any signs of violence, not even such as a fault. The gravel covers the entire surface of the land, from the Rio Colorado to the Strait of Magellan, a space of 800 miles, and is one chief cause of the desert character of Patagonia. Judging from a section across the continent at the St. Cruz river, and from some other reasons, I believe the gravel beds gradually thickening as they ascend, every where reach the base of the Cordillera. It is to these mountains we must look for the parent rocks, of at least a large portion of the well-rounded fragments. I apprehend so great an area covered by shingle, could scarcely be pointed out in any other part of the world.

Having said thus much of the constitution, let us look at the external configuration of the mass. The level plains are cut off along the whole line of coast by perpendicular cliffs, which are necessarily of different altitudes, because any one of the successive terraces, which, as I have already noticed, rise like steps one above the other, may form the sea cliff. These steps are often several miles broad; but from one point of view I have seen four very distinct lines of escarpment abutting one over the other. Having observed that the plains appeared to run for great distances along the coast at the same level, I measured barometrically the elevation of some of them, and compared these measurements, and took all those made by the officers employed in the survey. I was astonished to find at how great distances, even of 600 miles, plains occurred that had, within a few feet of difference, the same elevation. I believe I can distinguish seven or eight distinct terraces which occur along the line of coast, and which include heights between 1200 feet and the level of the sea. It will be understood that they are not always present, for the lower ones have in some parts been removed by the action of the sea sooner than in others. When any broad valley enters the country, the terraces sweep round and run up on each side; in which case, the correspondence on the opposite sides is beautifully illustrated.

I have called these step-like plains level, because they appear to be absolutely so to the eye, but in truth they rise a little between the edge of one line of cliff and the base of the next above it. Their slope is about the same as that of the gradually shoaling bottom of the neighbouring sea. The elevation of 350 feet is gained by three steps; one of about 100 feet, the second 250, and the third 350. Over these three plains marine remains are frequently scattered, but they are especially abundant on the lower one. The shells are the same as the now existing littoral species, and the muscle and turbo yet partially retain their blue and purple colours.

We have now stated the problem, which is to be explained so as to connect together these various phenomena. At first I could only understand the grand covering of gravel, by the supposition of some epoch of extreme violence, and the successive lines of cliff, by as many great elevations, the precise action of which I could not however follow out. Guided by the "Principles of Geology," and having under my view the vast changes going on in this continent, which at the present day seems the great workshop of nature, I came to another, and I hope more satisfactory conclusion. The importance of any view which may explain the agency by which such vast beds of shingle have been transported over the surface of the successive plains, cannot be doubted. Whatever the cause may have been, it has determined the condition of this desert country, with respect to its form, nature, and capabilities of supporting life.

There are proofs, that the whole coast has been elevated to a considerable height within the recent period; and on the shores of the Pacific, where successive terraces likewise occur, we know that these changes have latterly been very gradual. There is indeed reason for believing, that the uplifting of the ground during the earthquakes in Chile, although only to the height of two or three feet, has been a disturbance which may be considered as a great one, in comparison to the series of lesser and scarcely sensible movements which are likewise in progress. Let us then imagine

the consequence of the shoaling bed of an ocean, elevated at a perfectly equable rate, so that the same number of feet should be converted into dry land in each succeeding century. Every part of the surface would then have been exposed for an equal length of time to the action of the beach-line, and the whole in consequence equally modified. The shoaling bed of the ocean would thus be changed into a sloping land, with no marked line on it. If, however, there should occur a long period of repose in the elevations, and the currents of the sea should tend to wear away the land (as happens along this whole coast), then there would be formed a line of cliff. Accordingly as the repose was long, so would be the quantity of land consumed, and the consequent height of such cliffs. Let the elevations recommence, and another sloping bank (of shingle, or sand, or mud, according to the nature of the successive beach-lines) must be formed, which again will be broken by as many lines of cliff, as there shall be periods of rest in the action of the subterranean forces. Now this is the structure of the plains of Patagonia; and such gradual changes harmonize well with the undisturbed strata, extending over so many hundred miles.

I must here observe, that I am far from supposing that the entire coast of this part of the continent has ever been lifted up, to the height of even a foot, at any one moment of time; but, drawing our analogies from the shores of the Pacific, that the whole may have been insensibly rising, with every now and then a paroxysmal or accelerated movement in certain spots. With respect to the alternation of the periods of such continued rise and those of quiescence, we may grant that they are probable, because such alternation agrees with what we see in the action, not only of a single volcano, but likewise of the disturbances affecting whole regions of the earth. At the present day, to the north of the parallel 44°, the subterranean forces are constantly manifesting their power over a space of more than one thousand miles. But to the southward of that line, as far as Cape Horn, an earthquake is seldom or never experienced, and

there is not a single point of eruption; yet in former ages, as we shall hereafter show, deluges of lava flowed from that very part. It is in conformity with our hypothesis that this southern region of repose, is at present suffering from the inroads of the ocean, as attested by the long line of cliff on the Patagonian coast. Such we believe to have been the causes of this singular configuration of the land. Nevertheless, we confess that it at first appears startling, that the most marked intervals between the heights of the successive plains should, instead of some great and sudden action of the subterranean forces, only indicate a longer period of repose.

In explaining the widely-spread bed of gravel, we must first suppose a great mass of shingle to be collected by the action of innumerable torrents, and the swell of an open ocean, at the submarine basis of the Andes, prior to the elevation of the plains of Patagonia. If such a mass should then be lifted up, and left exposed during one of the periods of subterranean repose; a certain breadth, for instance a mile, would be washed down, and spread out over the bottom of the invading waters. (That the sea near the coast can carry out pebbles, we may feel sure from the circumstance of their gradual decrease in size, according to the distance from the coast-line.)

If this part of the sea should now be elevated, we should have a bed of gravel, but it would be of less thickness than in the first mass, both because it is spread over a larger area, and because it has been much reduced by attrition. This process being repeated, we might carry beds of gravel, always decreasing in thickness (as happens in Patagonia) to a considerable distance from the line of parent rock.* For instance, on the banks of the St. Cruz at the distance of one hundred

* It is needless to point out to the geologist, that this view, if correct, will account, without the necessity of any sudden rush of water, for the general covering of mixed shingle, so common in many parts of Europe, and likewise for the occurrence of widely-extended strata of conglomerate; for the superficial beds might, during a period of subsidence, be covered by fresh deposits.

miles above the mouth of the river, the bed of gravel is 212 feet thick, whereas, near the coast, it seldom exceeds 25 or 30 feet; the thickness being thus reduced to nearly one-eighth.

I have already stated that the gravel is separated from the fossiliferous strata by some white beds of a friable substance, singularly resembling chalk, but which cannot be compared, as far as I am aware, with any formation in Europe. With respect to its origin, I may observe that the well-rounded pebbles all consist of various felspathic porphyries; and that, from their prolonged attrition, during the successive remodellings of the whole mass, much sediment must have been produced. I have already remarked that the white earthy matter more closely resembles decomposed felspar, than any other substance. If such is its origin, it would always, from its lightness, be carried further to seaward than the pebbles. But as the land was elevated, the beds would be brought nearer the coast-line, and so become covered by the fresh masses of gravel which were travelling outwards. When these white beds were themselves elevated, they would hold a position intermediate between the gravel and the common foundation, or the fossiliferous strata. To explain my meaning more clearly, let us suppose the bottom of the present sea covered to a certain distance from the coast-line, with pebbles gradually decreasing in size, and beyond it by the white sediment. Let the land rise, so that the beach-line, by the fall of the water, may be carried outwards; then likewise the gravel, by the same agency as before, will be transported so much further from the coast, and will cover the white sediment, and these beds again will invade the more distant parts of the bottom of the sea. By this outward progress, the order of superposition must always be gravel, white sediment, and the fossiliferous strata.

Such is the history of the changes by which the present condition of Patagonia has, I believe, been determined. These changes all result from the assumption of a steady but very gradual elevation, extending over a wide area, and

interrupted at long intervals by periods of repose. But we must now return to Port St. Julian. On the south side of the harbour, a cliff of about ninety feet in height intersects a plain constituted of the formations above described; and its surface is strewed over with recent marine shells. The gravel, however, differently from that in every other locality, is covered by a very irregular and thin bed of a reddish loam, containing a few small calcareous concretions. The matter somewhat resembles that of the Pampas, and probably owes its origin either to a small stream having formerly entered the sea at that spot, or to a mud-bank similar to those now existing at the head of the harbour. In one spot this earthy matter filled up a hollow, or gully, worn quite through the gravel, and in this mass a group of large bones was embedded. The animal to which they belonged, must have lived, as in the case at Bahia Blanca, at a period long subsequent to the existence of the shells now inhabiting the coast. We may feel sure of this, because the formation of the lower terrace or plain, must necessarily have been posterior to those above it, and on the surface of the two higher ones, sea-shells of recent species are scattered. From the small physical change, which the last one hundred feet elevation of the continent could have produced, the climate, as well as the general condition of Patagonia, probably was nearly the same, at the time when the animal was embedded, as it now is. This conclusion is moreover supported by the identity of the shells belonging to the two ages. Then immediately occurred the difficulty, how could any large quadruped have subsisted on these wretched deserts in lat. 49° 15′? I had no idea at the time, to what kind of animal these remains belonged. The puzzle, however, was soon solved when Mr. Owen examined them; for he considers that they formed part of an animal allied to the guanaco or llama, but fully as large as the true camel. As all the existing members of the family of Camelidæ are inhabitants of the most sterile countries, so may we suppose was this extinct kind. The structure of the cervical vertebræ, the transverse processes

not being perforated for the vertebral artery, indicates its affinity: some other parts, however, of its structure, probably are anomalous.

The most important result of this discovery, is the confirmation of the law that existing animals have a close relation in form with extinct species. As the guanaco is the characteristic quadruped of Patagonia, and the vicuna of the snow-clad summits of the Cordillera, so in bygone days, this gigantic species of the same family must have been conspicuous on the southern plains. We see this same relation of type between the existing and fossil Ctenomys, between the capybara (but less plainly, as shown by Mr. Owen) and the gigantic Toxodon; and lastly, between the living and extinct Edentata. At the present day, in South America, there exist probably nineteen species of this order, distributed into several genera; while throughout the rest of the world there are but five. If, then, there is a relation between the living and the dead, we should expect that the Edentata would be numerous in the fossil state. I need only reply by enumerating the megatherium, and the three or four other great species, discovered at Bahia Blanca; the remains of some of which are also abundant over the whole immense territory of La Plata. I have already pointed out the singular relation between the armadilloes and their great prototypes, even in a point apparently of so little importance as their external covering.

The order of rodents at the present day, is most conspicuous in South America, on account of the vast number* and size of the species, and the multitude of individuals: according to the same law, we should expect to find their representatives in a fossil state. Mr. Owen has shown how far the Toxodon is thus related; and it is moreover not

* In my collection Mr. Waterhouse distinguishes twenty-seven species of mice; to these must be added about thirteen more, known from the works of Azara, and other naturalists; so that we have forty species, which have actually been described as coming from between the Tropic and Cape Horn.

improbable that another large animal has likewise a similar affinity.

The teeth of the rodent nearly equalling in size those of the Capybara, which were discovered near Bahia Blanca, must also be remembered.

The law of the succession of types, although subject to some remarkable exceptions, must possess the highest interest to every philosophical naturalist, and was first clearly observed in regard to Australia, where fossil remains of a large and extinct species of Kangaroo and other marsupial animals were discovered buried in a cave. In America the most marked change among the mammalia has been the loss of several species of Mastodon, of an elephant, and of the horse. These Pachydermata appear formerly to have had a range over the world, like that which deer and antelopes now hold. If Buffon had known of these gigantic armadilloes, llamas, great rodents, and lost pachydermata, he would have said with a greater semblance of truth, that the creative force in America had lost its vigour, rather than that it had never possessed such powers.

It is impossible to reflect without the deepest astonishment, on the changed state of this continent. Formerly it must have swarmed with great monsters, like the southern parts of Africa, but now we find only the tapir, guanaco, armadillo, and capybara; mere pigmies compared to the antecedent races. The greater number, if not all, of these extinct quadrupeds lived at a very recent period; and many of them were contemporaries of the existing molluscs. Since their loss, no very great physical changes can have taken place in the nature of the country. What then has exterminated so many living creatures? In the Pampas, the great sepulchre of such remains, there are no signs of violence, but on the contrary, of the most quiet and scarcely sensible changes. At Bahia Blanca I endeavoured to show the probability that the ancient Edentata, like the present species, lived in a dry and sterile country, such as now is found in that neighbourhood. With respect to the camel-like llama of Patagonia,

the same grounds which, before knowing more than the size of the remains, perplexed me, by not allowing any great change of climate, now that we can guess the habits of the animal, are strangely confirmed. What shall we say of the death of the fossil horse? Did those plains fail in pasture, which afterwards were overrun by thousands and tens of thousands of the successors of the fresh stock introduced with the Spanish colonist? In some countries, we may believe, that a number of species subsequently introduced, by consuming the food of the antecedent races, may have caused their extermination; but we can scarcely credit that the armadillo has devoured the food of the immense Megatherium, the capybara of the Toxodon, or the guanaco of the camel-like kind. But granting that all such changes have been small, yet we are so profoundly ignorant concerning the physiological relations, on which the life, and even health (as shown by epidemics) of any existing species depends, that we argue with still less safety about either the life or death of any extinct kind.

One is tempted to believe in such simple relations, as variation of climate and food, or introduction of enemies, or the increased numbers of other species, as the cause of the succession of races. But it may be asked whether it is probable than any such cause should have been in action during the same epoch over the whole northern hemisphere, so as to destroy the *Elephas primigenus*, on the shores of Spain, on the plains of Siberia, and in Northern America; and in a like manner, the *Bos urus*, over a range of scarcely less extent? Did such changes put a period to the life of *Mastodon angustidens*, and of the fossil horse, both in Europe and on the Eastern slope of the Cordillera in Southern America? If they did, they must have been changes common to the whole world; such as gradual refrigeration, whether from modifications of physical geography, or from central cooling. But on this assumption, we have to struggle with the difficulty that these supposed changes, although scarcely sufficient to affect molluscous

animals either in Europe or South America, yet destroyed many quadrupeds in regions now characterized by *frigid*, *temperate*, and *warm** climates! These cases of extinction forcibly recal the idea (I do not wish to draw any close analogy) of certain fruit-trees, which, it has been asserted, though grafted on young stems, planted in varied situations, and fertilized by the richest manures, yet at one period, have all withered away and perished. A fixed and determined length of life has in such cases been given to thousands and thousands of buds (or individual germs), although produced in long succession. Among the greater number of animals, each individual appears nearly independent of its kind; yet all of one kind may be bound together by common laws, as well as a certain number of individual buds in the tree, or polypi in the Zoophyte.

I will add one other remark. We see that whole series of animals, which have been created with peculiar kinds of organization, are confined to certain areas; and we can hardly suppose these structures are only adaptations to peculiarities of climate or country; for otherwise, animals belonging to a distinct type, and introduced by man, would not succeed so admirably, even to the extermination of the aborigines. On such grounds it does not seem a necessary conclusion, that the extinction of species, more than their creation, should exclusively depend on the nature (altered by physical changes) of their country. All that at present can be said with certainty, is that, as with the individual, so with the species, the hour of life has run its course, and is spent.

* The *Elephas primigenus* is thus circumstanced, having been found in Yorkshire (associated with recent shells: Lyell, vol. i., chap. vi.), in Siberia, and in the warm regions of lat. 31°, in North America. The remains of the Mastodon occur in Paraguay (and I believe in Brazil, in lat. 12°), as well as in the temperate plains south of the Plata.

CHAPTER X.

Santa Cruz—Expedition up river—Indians—Character of Patagonia—Basaltic platform—Immense streams of lava—Non-transport of blocks by river—Excavation of valley—Condor, range and habits—Cordillera—Erratic boulders of great size—Indian relics—Return to the ship.

SANTA CRUZ—PATAGONIA.

April 13th.—The Beagle anchored within the mouth of the Santa Cruz. This river is situated about sixty miles south of Port St. Julian. During the last voyage, Captain Stokes proceeded thirty miles up, but then, from the want of provisions, was obliged to return. Excepting what was discovered at that time, scarcely any thing was known about this large river. Captain FitzRoy now determined to follow its course as far as time would allow. On the 18th, three whale-boats started, carrying three weeks' provisions; and the party consisted of twenty-five souls—a force which would have been sufficient to have defied a host of Indians. With a strong flood-tide, and a fine day, we made a good run, soon drank some of the fresh water, and were at night nearly above the tidal influence.

The river here assumed a size and appearance, which, even at the highest point we ultimately reached, was scarcely diminished. It was generally from three to four hundred yards broad, and in the middle about seventeen feet deep. The rapidity of the current, which in its whole course runs at the rate of from four to six knots an hour, is perhaps its most remarkable feature. The water is of a fine blue colour, but with a slight milky tinge, and not so transparent as at first sight would have been expected. It flows over a bed of pebbles, like those which compose the beach and surrounding plains. Although its course is winding, it runs through a valley which extends in a direct line to the west-

ward. This valley varies from five to ten miles in breadth; it is bounded by step-formed terraces, which rise in most parts one above the other to the height of five hundred feet, and have on the opposite sides a remarkable correspondence.

April 19th.—Against so strong a current, it was of course quite impossible to row or sail. Consequently the three boats were fastened together head and stern, two hands left in each, and the rest came on shore to track. As the general arrangements, made by Captain FitzRoy, were very good for facilitating the work of all, and as all had a share of it, I will describe the system. The party, including every one, was divided into two spells, each of which hauled at the tracking line alternately for an hour and a half. The officers of each boat lived with, ate the same food, and slept in the same tent with their crew, so that each boat was quite independent of the others. After sunset, the first level spot where any bushes were growing, was chosen for our night's lodging. Each of the crew took it in turns to be cook. Immediately the boat was hauled up, the cook made his fire; two others pitched the tent; the coxswain handed the things out of the boat; the rest carried them up to the tents, and collected firewood. By this order, in half an hour, every thing was ready for the night. A watch of two men and an officer was always kept, whose duty it was to look after the boats, keep up the fire, and guard against Indians. Each in the party had his one hour every night.

During this day we tracked but a short distance, for there were many islets, covered by thorny bushes, and the channels between them were shallow.

April 20th.—We passed the islands and set to work. Our regular day's march, although it was hard enough, carried us on an average only ten miles in a straight line, and perhaps fifteen or twenty altogether. Beyond the place where we slept last night the country is completely *terra incognita*, for it was there that Captain Stokes turned back. We saw in the distance a great smoke, and found the skeleton of a horse, so we knew that Indians were in the neigh-

bourhood. On the next morning (21st) tracks of a party of horse, and marks left by the trailing of the chuzos were observed on the ground. It was generally thought they must have reconnoitred us during the night. Shortly afterwards we came to a spot, where from the fresh footsteps of men, children, and horses, it was evident the party had crossed the river.

April 22d.—The country remained the same, and was extremely uninteresting. The complete similarity of the productions throughout Patagonia, is one of its most striking characters. The level plains of arid shingle support the same stunted and dwarf plants; and in the valleys the same thorn-bearing bushes grow. Every where we see the same birds and insects. Even the very banks of the river, and of the clear streamlets which entered it, were scarcely enlivened by a brighter tint of green. The curse of sterility is on the land, and the water flowing over a bed of pebbles partakes of the same curse. Hence the number of waterfowl is very scanty; for what is there to support life in the stream of this barren river?

Patagonia, poor as she is in some respects, can, however, boast of a greater stock of small rodents* than, perhaps, any other country in the world. Several species of mice are externally characterized by large thin ears and a very fine fur. These little animals swarm amongst the thickets in the valleys, where they cannot for months together taste a drop of water. They all seem to be cannibals, for no sooner was a mouse caught in one of my traps than it was devoured by others. A small and delicately-shaped fox, which is likewise very abundant, probably derives its entire support from these small animals. The guanaco is also in his proper district; herds of fifty or a hundred were common; and, as I have said, we saw one which must have contained at least

* The deserts of Syria are characterized, according to Volney (vol. i., p. 351), by woody bushes, numerous rats, gazelles, and hares. In the landscape of Patagonia, the guanaco replaces the gazelle, and the agouti the hare.

five hundred. The puma with the condor in its train, follows and preys upon these animals. The footsteps of the former were to be seen almost every where on the banks of the river; and the remains of several guanaco, with their necks dislocated, and bones broken, showed how they had met their death.

April 24th.—Like the navigators of old when approaching an unknown land, we examined and watched for the most trivial sign of a change. The drifted trunk of a tree, or a boulder of primitive rock, was hailed with joy, as if we had seen a forest growing on the flanks of the Cordillera. The top, however, of a heavy bank of clouds, which remained almost constantly in one position, was the most promising sign, and eventually turned out true. At first the clouds were mistaken for the mountains themselves, instead of the masses of vapour condensed by their icy summits.

26th.—We this day met with a marked change in the geological structure of the plains. From the first starting I had carefully examined the gravel in the river, and for the two last days had noticed the presence of a few small pebbles of a very cellular basalt. These gradually increased in number and in size, but none equalled in dimensions a man's head. This morning, however, pebbles of the same rock, but more compact, suddenly became abundant, and in the course of half an hour, we saw at the distance of five or six miles the angular edge of a great basaltic platform. When we arrived at its base we found the stream bubbling among the fallen blocks. For the next twenty-eight miles, the river-course was encumbered with these basaltic masses. Above that limit, immense fragments belonging to a primitive formation, but derived from the surrounding alluvium, were equally numerous. In both cases no fragments at all remarkable in size or number had been washed down the stream, more than three or four miles below either the parent rock, or the mass of alluvium from which they were derived. Considering the singular rapidity of the great body of water in the St. Cruz, and that no still reaches occur in

any part, these examples are most striking of the inefficiency of rivers in transporting even moderately-sized fragments.

The basaltic cliffs are obscurely divided by lines of more cellular or amygdaloidal varieties, and the strata appear to the eye perfectly horizontal. They overlie the great tertiary deposits, and are covered (except where denuded in some of the lower terraces) by the usual beds of gravel. The basalt is clearly nothing more than lava, which has flowed beneath the sea; but the eruptions must have been on the grandest scale. At the point where we first met this formation, the mass was about 120 feet in thickness; following the river-course, it imperceptibly rose and became thicker, so that at forty miles above the first station it was 320 feet. What the thickness may be close to the Cordillera, I have no means of knowing, but the platform there attains an elevation between two and three thousand feet above the level of the sea: we must therefore look to the mountains of that great chain for its source; and worthy of such a source are streams, that have flowed over the bed of an ocean to a distance of one hundred miles.

A fine section of the basaltic platform is presented by the cliffs on both sides of the valley. At the first glance it is evident the strata must at one time have been united. What power then has removed along a whole line of country, a solid mass of very hard rock, which had an average thickness of about three hundred feet, and a breadth varying from rather less than two to four miles? The river, though it has so little power in transporting even inconsiderable fragments, yet in the lapse of ages might produce an effect by its gradual erosion, of which it is difficult to judge the limit. But in this case, independently of the insignificance of such agency, good reasons can be assigned for believing that this valley was formerly occupied by an arm of the sea. It is needless in this work to detail arguments, which chiefly rest on the form and nature of the banks, on the manner in which the valley near the foot of the Andes expands into a great bay, and on the occurrence of a few sea-shells lying in the

bed of the river. If I had space I could prove that South America was formerly here cut off by a strait joining the Atlantic and Pacific oceans, like that of Magellan. But it may yet be asked, how has the solid basalt been removed? Geologists formerly would have brought into play, the violent action of some overwhelming debacle; but in this case such a supposition would have been quite inadmissible; because the same step-like terraces, that front the Patagonian coast, sweep up on each side of the valley. No possible action of any flood could have thus modelled the land in these two situations; and by the formation of such terraces the valley itself has been hollowed out. Although we know that there are tides, which run within the narrows of the Strait of Magellan at the rate of eight knots an hour, yet we must confess it makes the head almost giddy to reflect on the number of years, century after century, which the tides unaided by a heavy surf, must have required to have corroded so vast an area and thickness of solid rock. Nevertheless, we must believe that the strata undermined by the waters of this ancient strait, were broken up into huge fragments, and there lying scattered on the beach, were reduced to smaller blocks, then to pebbles, and lastly to the most impalpable mud, which the tides drifted into the bed, either of the Eastern or Western Ocean.

With the change in the geological structure of the plains the character of the landscape likewise altered. While rambling up some of the narrow and rocky defiles, I could almost have fancied myself transported back again to the barren valleys of St. Jago. Among the basaltic cliffs, I found some plants which I had seen nowhere else, but others I recognised as being wanderers from Tierra del Fuego. These porous rocks serve as a reservoir for the scanty rain-water, and consequently on the line where the igneous and sedimentary formations unite, several small springs (most rare occurrences in Patagonia) burst forth; and they could be distinguished at a distance by the circumscribed patch of bright green herbage.

April 27th.—The bed of the river became rather narrower, and hence the stream more rapid. It here ran at the rate of six knots an hour. From this cause, and from the many great angular fragments, tracking the boats became both dangerous and laborious.

This day I shot a condor. It measured from tip to tip of the wings, eight and a half feet, and from beak to tail, four feet. It is a magnificent spectacle to behold several of these great birds seated on the edge of some steep precipice. I will here describe all I have observed respecting their habits. The condor is known to have a wide geographical range, being found on the west coast of South America, from the Strait of Magellan throughout the entire range of the Cordillera. On the Patagonian shore, the steep cliff near the mouth of the Rio Negro in lat. 41°, was the most northern point where I saw these birds, or heard of their existence. They have there wandered about four hundred miles from the great central line of their habitation in the Andes. Further south, among the bold precipices which form the head of Port Desire, they are not uncommon; yet only a few stragglers occasionally visit the sea-coast. A line of cliff near the mouth of St. Cruz, is frequented by these birds, and about eighty miles up the river, where first the sides of the valley were formed by steep basaltic precipices, the condor again appeared, although in the intermediate space not one had been seen. From these and similar facts, the presence of this bird seems chiefly to be determined by the occurrence of perpendicular cliffs. In Patagonia, the condors either by pairs or many together, both sleep and breed on the same overhanging ledges. In Chile, during the greater part of the year, they haunt the lower country near the shores of the Pacific, and at night several roost in one tree; but in the early part of summer, they retire to the most inaccessible parts of the inner Cordillera, there to breed in peace.

With respect to their propagation, I was told by the country people in Chile, that the condor makes no sort of

nest, but in the months of November and December lays two large white eggs on a shelf of bare rock. On the Patagonian coast I could not see any sort of nest among the cliffs, where the young ones were standing. It is said the young condors cannot fly for an entire year. At Concepcion, on the fifth of March (corresponding to our September), I saw a young bird, which, though in size little inferior to an old one, was completely covered by down like that of a gosling, but of a blackish colour. I feel sure this bird could not have used its wings for flight for many months. After the period when the young condors can fly, and apparently as well as the old birds, they yet remain both roosting at night on the same ledge, and hunting by day with their parents. Before, however, the young bird has the ruff round its neck turned white, it may often be seen hunting by itself. At the mouth of the St. Cruz, during part of April and May, a pair of old birds might be seen every day either perched on a certain ledge, or sailing about in company with a single young one, which latter though full fledged, had not its ruff white. I should think, especially when recollecting the state in which the Concepcion bird was on the previous month, that this young condor had not been hatched from an egg of that summer. As there were no other young birds, it seems probable that the condor only lays once in two years.

These birds generally live by pairs; but among the inland basaltic cliffs of the St. Cruz, I found a spot, where scores most usually haunt. On coming suddenly to the brow of the precipice, it was a fine sight to see between twenty and thirty of these great birds start heavily from their resting-place, and wheel away in majestic circles. From the quantity of dung on the rocks, they must long have frequented this cliff, and probably they both roost and breed there. Having gorged themselves with carrion on the plains below, they retire to these favourite ledges, to digest their food. From these facts, the condor must to a certain

degree, like the gallinazo, be considered a gregarious bird. In this part of the country they live altogether on the guanacoes, which either have died a natural death, or, as more commonly happens, have been killed by the pumas. I believe, from what I saw in Patagonia, that they do not on ordinary occasions extend their daily excursions to any great distance from their regular sleeping-places.

The condors may oftentimes be seen at a great height, soaring over a certain spot in the most graceful spires and circles. On some occasions I am sure that they do this for sport, but on others, the Chileno countrymen tell you that they are watching a dying animal, or the puma devouring its prey. If the condors glide down, and then suddenly all rise together, the Chileno knows that it is the puma which, watching the carcass, has sprung out to drive away the robbers. Besides feeding on carrion, the condors will frequently attack young goats and lambs. Hence the shepherd dogs are trained, the moment the enemy passes over, to run out, and looking upwards, to bark violently. The Chilenos destroy and catch numbers. Two methods are used; one is to place a carcass within an enclosure of sticks on a level piece of ground, and when the condors are gorged, to gallop up on horseback to the entrance, and thus enclose them: for when this bird has not space to run, it cannot give its body sufficient momentum to rise from the ground. The second method is to mark the trees in which, frequently to the number of five or six, they roost together, and then at night to climb up and noose them. They are such heavy sleepers, as I have myself witnessed, that this is not a difficult task. At Valparaiso, I have seen a living condor sold for sixpence, but the common price is eight or ten shillings. One which I saw brought in, had been lashed with rope, and was much injured; yet, the moment the line was cut by which its bill was secured, although surrounded by people, it began ravenously to tear a piece of carrion. In a garden at the same place, between twenty and thirty were kept alive. They were fed only once a week, but they

appeared in pretty good health.* The Chileno countrymen assert that the condor will live and retain its powers, between five and six weeks without eating. I cannot answer for the truth of this, but it is a cruel experiment, which very likely has been tried.

When an animal is killed in the country, it is well known that the condors, like other carrion vultures, soon gain intelligence of it, and congregate in an inexplicable manner. In most cases it must not be overlooked, that the birds have discovered their prey, and have picked the skeleton clean, before the flesh is in the least tainted. Remembering the opinions of M. Audubon, on the little smelling powers of such birds,† I tried in the above-mentioned garden the following experiment: The condors were tied, each by a rope, in a long row at the bottom of a wall. Having folded up a piece of meat in white paper, I walked backwards and forwards, carrying it in my hand at the distance of about three yards, but no notice whatever was taken. I then threw it on the ground, within one yard of an old cock bird; he looked at it for a moment with attention, but then regarded it no more. With a stick I pushed it closer and closer, until at last he touched it with his beak; the paper was then instantly torn off with fury, and at the same moment, every bird in the long row began

* I noticed that several hours before any of the condors died, all the lice, with which they are infested, crawled to the outside feathers. I was told that this was always the case.

† In the case of the *Vultur aura*, Mr. Owen, in some notes read before the Zoological Society, has demonstrated from the developed form of the olfactory nerves, that this bird must possess an acute sense of smell. It was mentioned on the same evening, that on two occasions, persons in the West Indies having died, and their bodies not being buried till they smelt offensively, these birds congregated in numbers on the roof of the house. This instance appears quite conclusive, as it was evident they had gained the intelligence by the powers of smell alone, and not of sight. It would appear from the various facts recorded, that carrion-feeding hawks possess both the sense of sight and smell in an eminent degree.

struggling and flapping its wings. Under the same circumstances, it would not have been possible to have deceived a dog.

I may remark, that oftentimes when lying down to rest on the open plains, and on looking upwards, I have seen carrion hawks, sailing through the air at a great height. Where the country is level I do not believe a space of the heavens, of more than 15° above the horizon, is commonly viewed with any attention by a person either walking or on horseback. If such is the case, and the vulture is on the wing at a height of between three and four thousand feet, before it could come within the above range of vision, its distance in a straight line from the beholder's eye, would be rather more than two British miles. Might it not thus readily be overlooked? When an animal is killed by the sportsman in a lonely valley, may he not all the while be watched from above by the sharp-sighted bird? And will not the manner of its descent proclaim throughout the district to the whole family of carrion-feeders, that their prey is at hand?

When the condors in a flock are wheeling round and round any spot, their flight is beautiful. Except when rising from the ground, I do not recollect ever having seen one of these birds flap its wings. Near Lima, I watched several for nearly half an hour, without once taking off my eyes. They moved in large curves, sweeping in circles, descending and ascending without once flapping. As they glided close over my head, I intently watched, from an oblique position, the outlines of the separate and terminal feathers of the wing, if there had been the least vibratory movement, these would have been blended together, but they were seen distinct against the blue sky. The head and neck were moved frequently, and apparently with force, and it appeared as if the extended wings formed the fulcrum on which the movements of the neck, body, and tail, acted. If the bird wished to descend, the wings were for a moment collapsed; and then when again expanded with an altered inclination,

the momentum gained by the rapid descent seemed to urge the bird upwards, with the even and steady movement of a paper kite. In the case of any bird *soaring*, its motion must be sufficiently rapid, so that the action of the inclined surface of its body on the atmosphere, may counterbalance its gravity. The force to keep up the momentum of a body moving in a horizontal plane in that fluid (in which there is so little friction) cannot be great, and this force is all that is wanted. The movement of the neck and body of the condor, we must suppose, is sufficient for this. However this may be, it is truly wonderful and beautiful to see so great a bird, hour after hour, without any apparent exertion, wheeling and gliding over mountain and river.

April 29th.—From some high land we hailed with joy the white summits of the Cordillera, as they were seen occasionally peeping through their dusky envelope of clouds. During the few succeeding days, we continued to get on slowly, for we found the river-course very tortuous, and strewed with immense fragments of various ancient slaty rocks, and of granite. The plain bordering the valley had here attained an elevation of about 1100 feet, and its character was much altered. The well-rounded pebbles of porphyry were in this part mingled with many immense angular fragments of basalt and of the rocks above mentioned. The first of these erratic blocks which I noticed, was sixty-seven miles distant from the nearest mountain; another which had been transported to rather a less distance, measured five yards square, and projected five feet above the gravel. Its edges were so angular, and its size so great, that I at first mistook it for a rock *in situ*, and took out my compass to observe the direction of its cleavage. The plains here were not quite so level as those nearer the coast, but yet, they betrayed little signs of any violent action. Under these circumstances, it would be difficult, as it appears to me, to explain this phenomenon on any theory, excepting through that of transport by ice while the country was under water. But this is a subject to which I shall again recur.

During the two last days we met with signs of horses, and with several small articles which had belonged to the Indians, —such as parts of a mantle and a bunch of ostrich feathers— but they appeared to have been lying long on the ground. Between the place where the Indians had so lately crossed the river and this neighbourhood, though so many miles apart, the country appears to be quite unfrequented. At first, considering the abundance of the guanacoes, I was surprised at this; but it is explained by the stony nature of the plains, which would soon disable an unshod horse from taking part in the chase. Nevertheless, in two places in this very central region, I found small heaps of stones, which I do not think could have been accidentally thrown together. They were placed on points, projecting over the edge of the highest lava cliff, and they resembled, but on a small scale, those near Port Desire.

May 4th.—Captain FitzRoy determined to take the boats no higher. The river had a winding course, and was very rapid; and the appearance of the country offered no temptation to proceed any further. Every where we met with the same productions, and the same dreary landscape. We were now one hundred and forty miles distant from the Atlantic, and about sixty from the nearest arm of the Pacific. The valley in this upper part expanded into a wide basin, bounded on the north and south by the basaltic platforms, and fronted by the long range of the snow-clad Cordillera. But we viewed these grand mountains with regret, for we were obliged to imagine their form and nature, instead of standing, as we had hoped, on their crest, and looking down on the plain below. Besides the useless loss of time which an attempt to ascend any higher would have cost us, we had already been for some days on half allowance of bread. This, although really enough for any reasonable men, was, after our hard day's march, rather scanty food. Let those alone who have never tried it, exclaim about the comfort of a light stomach and an easy digestion.

5th.—Before sunrise we commenced our descent. We

shot down the stream with great rapidity, generally at the rate of ten knots an hour. In this one day we effected what had cost us five-and-a-half hard days' labour in ascending. On the 8th, we reached the Beagle after our twenty-one days' expedition. Every one excepting myself had cause to be dissatisfied; but to me the ascent afforded a most interesting section of the great tertiary formation of Patagonia.

CHAPTER XI.

Tierra del Fuego, first arrival—Good Success Bay—Interview with savages—Scenery of the forests—Sir J. Banks's hill—Cape Horn—Wigwam Cove—Miserable condition of savages—Beagle channel—Fuegians—Ponsonby Sound—Equality of condition among natives—Bifurcation of Beagle channel—Glaciers—Return to ship.

TIERRA DEL FUEGO.

December 17th, 1832.—Having now finished with Patagonia, I will describe our first arrival in Tierra del Fuego. A little after noon we doubled Cape St. Diego, and entered the famous strait of Le Maire. We kept close to the Fuegian shore, but the outline of the rugged, inhospitable Staten land was visible amidst the clouds. In the afternoon we anchored in the bay of Good Success. While entering we were saluted in a manner becoming the inhabitants of this savage land. A group of Fuegians partly concealed by the entangled forest, were perched on a wild point overhanging the sea; and as we passed by, they sprang up, and waving their tattered cloaks sent forth a loud and sonorous shout. The savages followed the ship, and just before dark we saw their fire, and again heard their wild cry. The harbour consists of a fine piece of water half surrounded by low rounded mountains of clay-slate, which are covered to the water's edge by one dense gloomy forest. A single glance at the landscape was sufficient to show me, how widely different it was from any thing I had ever beheld. At night it blew a gale of wind, and heavy squalls from the mountains swept past us. It would have been a bad time out at sea, and we, as well as others, may call this Good Success Bay.

In the morning, the Captain sent a party to communicate with the Fuegians. When we came within hail, one of the four natives who were present advanced to receive us, and

began to shout most vehemently, wishing to direct us where to land. When we were on shore the party looked rather alarmed, but continued talking and making gestures with great rapidity. It was without exception the most curious and interesting spectacle I had ever beheld. I could not have believed how wide was the difference, between savage and civilized man. It is greater than between a wild and domesticated animal, in as much as in man there is a greater power of improvement. The chief spokesman was old, and appeared to be the head of the family; the three others were powerful young men, about six feet high. The women and children had been sent away. These Fuegians are a very different race from the stunted miserable wretches further to the westward. They are much superior in person, and seem closely allied to the famous Patagonians of the Strait of Magellan. Their only garment consists of a mantle made of guanaco skin, with the wool outside; this they wear just thrown over their shoulders, as often leaving their persons exposed as covered. Their skin is of a dirty coppery red colour.

The old man had a fillet of white feathers tied round his head, which partly confined his black, coarse, and entangled hair. His face was crossed by two broad transverse bars; one painted bright red reached from ear to ear, and included the upper lip; the other, white like chalk, extended parallel and above the first, so that even his eyelids were thus coloured. Some of the other men were ornamented by streaks of black powder, made of charcoal. The party altogether closely resembled the devils which come on the stage in such plays as Der Freischutz.

Their very attitudes were abject, and the expression of their countenances distrustful, surprised, and startled. After we had presented them with some scarlet cloth, which they immediately tied round their necks, they became good friends. This was shown by the old man patting our breasts, and making a chuckling kind of noise, as people do when feeding chickens. I walked with the old man, and

this demonstration of friendship was repeated several times; it was concluded by three hard slaps, which were given me on the breast and back at the same time. He then bared his bosom for me to return the compliment, which being done, he seemed highly pleased. The language of these people, according to our notions, scarcely deserves to be called articulate. Captain Cook has compared it to a man clearing his throat, but certainly no European ever cleared his throat with so many hoarse, guttural, and clicking sounds.

They are excellent mimics: as often as we coughed or yawned, or made any odd motion, they immediately imitated us. Some of our party began to squint and look awry; but one of the young Fuegians (whose whole face was painted black, excepting a white band across his eyes) succeeded in making far more hideous grimaces. They could repeat with perfect correctness, each word in any sentence we addressed them, and they remembered such words for some time. Yet we Europeans all know how difficult it is to distinguish apart the sounds in a foreign language. Which of us, for instance, could follow an American Indian through a sentence of more than three words? All savages appear to possess, to an uncommon degree, this power of mimicry. I was told almost in the same words, of the same ludicrous habits among the Caffres: the Australians, likewise, have long been notorious for being able to imitate and describe the gait of any man, so that he may be recognised. How can this faculty be explained? is it a consequence of the more practised habits of perception and keener senses, common to all men in a savage state, as compared to those long civilized?

When a song was struck up by our party, I thought the Fuegians would have fallen down with astonishment. With equal surprise they viewed our dancing; but one of the young men, when asked, had no objection to a little waltzing. Little accustomed to Europeans as they appeared to be, yet they knew, and dreaded our fire-arms; nothing would tempt them to take a gun in their hands. They begged for

knives, calling them by the Spanish word "cuchilla." They explained also what they wanted, by acting as if they had a piece of blubber in their mouth, and then pretending to cut instead of tear it.

It was interesting to watch the conduct of these people towards Jemmy Button (one of the Fuegians* who had been taken, during the former voyage, to England): they immediately perceived the difference between him and the rest, and held much conversation between themselves on the subject. The old man addressed a long harangue to Jemmy, which it seems was to invite him to stay with them. But Jemmy understood very little of their language, and was, moreover, thoroughly ashamed of his countrymen. When York Minster (another of these men) came on shore, they noticed him in the same way, and told him he ought to shave; yet he had not twenty dwarf hairs on his face, whilst we all wore our untrimmed beards. They examined the colour of his skin, and compared it with ours. One of our arms being bared, they expressed the liveliest surprise and admiration at its whiteness. We thought that they mistook two or three of the officers, who were rather shorter and fairer (though adorned with large beards), for the ladies of our party. The tallest amongst the Fuegians was evidently much pleased at his height being noticed. When placed back to back with the tallest of the boat's crew, he tried his best to edge on higher ground, and to stand on tiptoe. He opened his mouth to show his teeth, and turned his face for a side view; and all this was done with such alacrity, that I dare say he thought himself the handsomest man in Tierra del Fuego. After the first feeling on our part of grave astonishment was over, nothing could be more ludicrous or interesting than the odd mixture of surprise and imitation which these savages every moment exhibited.

* Captain FitzRoy has given a history of these people. Four were taken to England; one died there, and the three others (two men and one woman) were now brought back and settled in their own country.

The next day I attempted to penetrate some way into the country. Tierra del Fuego may be described as a mountainous country, partly submerged in the sea, so that deep islets and bays occupy the place where valleys should exist. The mountain sides (except on the exposed western coast) are covered from the water's edge upwards by one great forest. The trees reach to an elevation of between 1000 and 1500 feet; and are succeeded by a band of peat, with minute alpine plants; and this again is succeeded by the line of perpetual snow, which, according to Captain King, in the Strait of Magellan descends to between 3000 and 4000 feet. To find an acre of level land in any part of the country is most rare. I recollect only one little flat near Port Famine, and another of rather larger extent near Goeree Road. In both these cases, and in all others, the surface was covered by a thick bed of swampy peat. Even within the forest the ground is concealed by a mass of slowly putrefying vegetable matter, which, from being soaked with water, yields to the foot.

Finding it nearly hopeless to push my way through the wood, I followed the course of a mountain torrent. At first, from the waterfalls and number of dead trees, I could hardly crawl along; but the bed of the stream soon became a little more open, from the floods having swept the sides. I continued slowly to advance for an hour along the broken and rocky banks; and was amply repaid by the grandeur of the scene. The gloomy depth of the ravine well accorded with the universal signs of violence. On every side were lying irregular masses of rock and up-torn trees; other trees, though still erect, were decayed to the heart and ready to fall. The entangled mass of the thriving and the fallen reminded me of the forests within the tropics;—yet there was a difference; for in these still solitudes, Death, instead of Life, seemed the predominant spirit. I followed the watercourse till I came to a spot where a great slip had cleared a straight space down the mountain side. By this road I ascended to a considerable elevation, and obtained a good view of the surrounding woods. The trees all belong to one kind,

the *Fagus betuloides*, for the number of the other species of beech, and of the Winter's bark, is quite inconsiderable. This tree keeps its leaves throughout the year; but its foliage is of a peculiar brownish-green colour, with a tinge of yellow. As the whole landscape is thus coloured, it has a sombre, dull appearance; nor is it often enlivened by the rays of the sun.

December 20th.—One side of the harbour is formed by a hill about 1500 feet high, which Captain FitzRoy has called after Sir J. Banks, in commemoration of his disastrous excursion, which proved fatal to two of his party, and nearly so to Dr. Solander. The snowstorm, which was the cause of their misfortune, happened in the middle of January, corresponding to our July, and in the latitude of Durham! I was anxious to reach the summit of this mountain to collect alpine plants; for flowers of any kind, in the lower part, were few in number. We followed the same watercourse as on the previous day, till it dwindled away, and then were compelled to crawl blindly among the trees. These, from the effects of the elevation, and of the impetuous winds, were low, thick, and crooked. At length we reached that which from a distance appeared like a carpet of fine green turf, but which, to our vexation, turned out to be a compact mass of little beech-trees about four or five feet high. These were as thick together as box in the border of a flower-garden, and we were obliged to struggle over the flat but treacherous surface. After a little more trouble we gained the peat, and then the bare slate rock.

A ridge connected this hill with another, distant some miles, and more lofty, so that patches of snow were lying on it. As the day was not far advanced, I determined to walk there and collect along the road. It would have been very hard work, had it not been for a well-beaten and straight path made by the guanacoes; for these animals, like sheep, always follow the same line. When we reached the hill we found it the highest in the immediate neighbourhood, and the waters flowed to the sea in opposite directions. We obtained a

wide view over the surrounding country: to the northward a swampy moorland extended, but to the southward we had a scene of savage magnificence, well becoming Tierra del Fuego. There was a degree of mysterious grandeur in mountain behind mountain, with the deep intervening valleys, all covered by one thick, dusky mass of forest. The atmosphere, likewise, in this climate (where gale succeeds gale, with rain, hail, and sleet), seems blacker than any where else. In the Strait of Magellan looking due south from Port Famine, the distant channels between the mountains appear from their gloominess to lead beyond the confines of this world.

December 21st.—The Beagle got under way: and on the succeeding day, favoured to an uncommon degree by a fine easterly breeze, we closed in with the Barnevelts, and, running past Cape Deceit with its stony peaks, about three o'clock doubled the weatherbeaten Cape Horn. The evening was calm and bright, and we enjoyed a fine view of the surrounding isles. Cape Horn, however, demanded his tribute, and before night sent us a gale of wind directly in our teeth. We stood out to sea, and on the second day again made the land, when we saw on our weather-bow this notorious promontory in its proper form—veiled in a mist, and its dim outline surrounded by a storm of wind and water. Great black clouds were rolling across the heavens, and squalls of rain, with hail, swept by us with extreme violence; so that the captain determined to run into Wigwam Cove. This is a snug little harbour, not far from Cape Horn; and here, at Christmas-eve, we anchored in smooth water. The only thing which reminded us of the gale outside, was every now and then a puff from the mountains, which seemed to wish to blow us out of the water.

December 25th.—Close by the cove, a pointed hill, called Kater's Peak, rises to the height of 1700 feet. The surrounding islands all consist of conical masses of greenstone, associated sometimes with less regular hills of baked

and altered clay-slate. This part of Tierra del Fuego may be considered as the extremity of the submerged chain of mountains already alluded to. The cove takes its name of "Wigwam" from some of the Fuegian habitations; but every bay in the neighbourhood might be so called with equal propriety. The inhabitants living chiefly upon shell-fish, are obliged constantly to change their place of residence; but they return at intervals to the same spots, as is evident from the pile of old shells, which must often amount to some tons in weight. These heaps can be distinguished at a long distance by the bright green colour of certain plants, which invariably grow on them. Among these may be enumerated the wild celery and scurvy grass, two very serviceable plants, the use of which has not been discovered by the natives.

The Fuegian wigwam resembles, in size and dimensions, a haycock. It merely consists of a few broken branches stuck in the ground, and very imperfectly thatched on one side with a few tufts of grass and rushes. The whole cannot be so much as the work of an hour, and it is only used for a few days. At Goeree Roads I saw a place where one of these naked men had slept, which absolutely offered no more cover than the form of a hare. The man was evidently living by himself, and York Minster said he was "very bad man," and that probably he had stolen something. On the west coast, however, the wigwams are rather better, for they are covered with seal-skins. We were detained here several days by the bad weather. The climate is certainly wretched; the summer solstice was now passed, yet every day snow fell on the hills, and in the valleys there was rain, accompanied by sleet. The thermometer generally stood about 45°, but in the night fell to 38° or 40°. From the damp and boisterous state of the atmosphere, not cheered by a gleam of sunshine, one fancied the climate even worse than it really was.

At a subsequent period the Beagle anchored for a couple of days under Wollaston Island, which is a short way to the northward. While going on shore we pulled alongside a

canoe with six Fuegians. These were the most abject and miserable creatures I any where beheld.* On the east coast the natives, as we have seen, have guanaco cloaks, and on the west, they possess seal-skins. Amongst these central tribes the men generally possess an otter-skin, or some small scrap about as large as a pocket-handkerchief, which is barely sufficient to cover their backs as low down as their loins. It is laced across the breast by strings, and according as the wind blows, it is shifted from side to side. But these Fuegians in the canoe were quite naked, and even one full-grown woman was absolutely so. It was raining heavily, and the fresh water, together with the spray, trickled down her body. In another harbour not far distant, a woman, who was suckling a recently-born child, came one day alongside the vessel, and remained there whilst the sleet fell and thawed on her naked bosom, and on the skin of her naked child. These poor wretches were stunted in their growth, their hideous faces bedaubed with white paint, their skins filthy and greasy, their hair entangled, their voices discordant, their gestures violent and without dignity. Viewing such men, one can hardly make oneself believe they are fellow-creatures, and inhabitants of the same world. It is a common subject of conjecture what pleasure in life some of the less gifted animals can enjoy: how much more reason-

* I believe, in this extreme part of South America, man exists in a lower state of improvement than in any other part of the world. The South Sea islander of either race is comparatively civilized. The Esquimaux, in his subterranean hut, enjoys some of the comforts of life, and in his canoe, when fully equipped, manifests much skill. Some of the tribes of Southern Africa, prowling about in search of roots, and living concealed on the wild and arid plains, are sufficiently wretched. But the Australian, in the simplicity of the arts of life, comes nearest the Fuegian. He can, however, boast of his boomerang, his spear and throwing-stick, his method of climbing trees, tracking animals, and scheme of hunting. Although thus superior in acquirements, it by no means follows that he should likewise be so in capabilities. Indeed, from what we saw of the Fuegians, who were taken to England, I should think the case was the reverse.

ably the same question may be asked with respect to these barbarians. At night, five or six human beings, naked and scarcely protected from the wind and rain of this tempestuous climate, sleep on the wet ground coiled up like animals. Whenever it is low water, they must rise to pick shell-fish from the rocks; and the women, winter and summer, either dive to collect sea eggs, or sit patiently in their canoes, and, with a baited hair-line, jerk out small fish. If a seal is killed, or the floating carcass of a putrid whale discovered, it is a feast: such miserable food is assisted by a few tasteless berries and fungi. Nor are they exempt from famine, and, as a consequence, cannibalism accompanied by parricide.

The tribes have no government or head, yet each is surrounded by other hostile ones, speaking different dialects; and the cause of their warfare would appear to be the means of subsistence. Their country is a broken mass of wild rock, lofty hills, and useless forests: and these are viewed through mists and endless storms. The habitable land is reduced to the stones which form the beach; in search of food they are compelled to wander from spot to spot, and so steep is the coast, that they can only move about in their wretched canoes. They cannot know the feeling of having a home, and still less that of domestic affection; unless indeed the treatment of a master to a laborious slave can be considered as such. How little can the higher powers of the mind be brought into play! What is there for imagination to picture, for reason to compare, for judgment to decide upon? to knock a limpet from the rock does not even require cunning, that lowest power of the mind. Their skill in some respects may be compared to the instinct of animals; for it is not improved by experience: the canoe, their most ingenious work, poor as it is, has remained the same, for the last two hundred and fifty years.

Whilst beholding these savages, one asks, whence have they come? What could have tempted, or what change compelled a tribe of men to leave the fine regions of

the north, to travel down the Cordillera or backbone of America, to invent and build canoes, and then to enter on one of the most inhospitable countries within the limits of the globe? Although such reflections must at first occupy one's mind, yet we may feel sure that many of them are quite erroneous. There is no reason to believe that the Fuegians decrease in number; therefore we must suppose that they enjoy a sufficient share of happiness (of whatever kind it may be) to render life worth having. Nature by making habit omnipotent, and its effects hereditary, has fitted the Fuegian to the climate and the productions of his country.

January 15th, 1833.—The Beagle anchored in Goeree Roads. Captain FitzRoy having determined to settle the Fuegians, according to their wishes, in Ponsonby Sound, four boats were equipped to carry them there through the Beagle channel. This channel which was discovered by Captain FitzRoy during the last voyage, is a most remarkable feature in the geography of this, or indeed of any other country. Its length is about 120 miles with an average breadth, not subject to any very great variations, of about two miles. It is throughout the greater part so extremely straight, that the view, bounded on each side by a line of mountains, gradually becomes indistinct in the perspective. This arm of the sea may be compared to the valley of Lochness in Scotland, with its chain of lakes and entering friths. At some future epoch the resemblance perhaps will become complete. Already in one part we have proofs of a rising of the land in a line of cliff, or terrace, composed of coarse sandstone, mud, and shingle, which forms both shores. The Beagle channel crosses the southern part of Tierra del Fuego in an east and west line; in its middle, it is joined on the south side by an irregular channel at right angles to it, which has been called Ponsonby Sound. This is the residence of Jemmy Button's tribe and family.

January 19th.—Three whale boats and the yawl, with a

party of twenty-eight, started under the command of Captain FitzRoy. In the afternoon we entered the eastern mouth of the channel, and shortly afterwards found a snug little cove, concealed by some surrounding islets. Here we pitched our tents, and lighted our fires. Nothing could look more comfortable than this scene. The glassy water of the little harbour, with the trees sending their branches over the rocky beach, the boats at anchor, the tents supported by the crossed oars, and the smoke curling up the wooded valley, formed a picture of quiet retirement. The next day (20th) we smoothly glided onwards in our little fleet, and came to a more inhabited district. Few if any of these natives could ever have seen a white man; certainly nothing could exceed their astonishment at the apparition of the four boats. Fires were lighted on every point (hence the name of the land), both to attract our attention, and to spread far and wide the news. Some of the men ran for miles along the shore. As we passed under one cliff, four or five men suddenly appeared above us, forming the most wild and savage group that can be imagined. They were absolutely naked, with long streaming hair, and with rugged staffs in their hands: springing from the ground they waved their arms around their heads, and sent forth the most hideous yells.

At dinner-time we landed among a party of Fuegians. At first they were not inclined to be friendly; for until the captain pulled in ahead of the other boats, they kept their slings in their hands. We soon, however, delighted them by trifling presents, such as tying red tape round their heads. It was as easy to please, as it was difficult to satisfy these savages. Young and old, men and children, never ceased repeating the word "yammerschooner," which means "give me." After pointing to almost every object, one after the other, even to the buttons on our coats, and saying their favourite word in as many intonations as possible, they would then use it in a neuter sense, and vacantly repeat "yammerschooner." After yammerschoonering for any article very eagerly, they would

by a simple artifice point to their young women or little children, as much as to say, "If you will not give it me, surely you will to such as these?"

At night we endeavoured in vain to find an uninhabited cove; and at last were obliged to bivouac not far from a party of natives. They were very inoffensive as long as they were few in numbers, but in the morning (21st) being joined by others they showed symptoms of hostility. An European labours under great disadvantages, when treating with savages like these, who have not the least idea of the power of fire-arms. In the very act of levelling his musket, he appears to the savage far inferior to a man armed with a bow and arrow, a spear, or even a sling. Nor is it easy to teach them our superiority except by striking a fatal blow. Like wild beasts they do not appear in all cases to compare numbers; for each individual if attacked, instead of retiring, will endeavour to dash your brains out with a stone, as certainly as a tiger under similar circumstances would tear you. Captain FitzRoy on one occasion, being very anxious from good reasons to frighten away a small party, twice fired his pistol close by the side of a native. The man both times looked astounded, and carefully but quickly rubbed his head; he then stared awhile, and gabbled to his companions; but he never seemed to think of running away. We can hardly put ourselves in the position of these savages, to understand their actions. In the case of the Fuegian, the possibility of such a sound as the report of a gun close to his ear, could never have entered his mind. He perhaps literally did not for a second know whether it was a sound or a blow, and therefore very naturally rubbed his head. In a similar manner, when a savage sees a mark struck by a bullet, it may be some time before he is able at all to understand how it is effected; for the fact of a body being invisible from its velocity, would perhaps be to him an idea totally inconceivable. Moreover, the extreme force of a bullet, that penetrates a hard substance without tearing it, may convince the savage that it has no force at all. Certainly I believe that many savages of the lowest grade,

such as these of Tierra del Fuego, have seen objects struck, and even small animals killed by the musket, without being in the least aware how deadly an instrument it was.

22D.—After having passed an unmolested night, in what would appear to be neutral territory. between Jemmy's tribe and the people we saw yesterday, we sailed pleasantly along. The scenery in this part had a peculiar and very magnificent character; although the effect was lessened from the lowness of the point of view in a boat, and from looking down the valley and hence losing all the beauty of a succession of ridges. The mountains attained an elevation of about 3000 feet, and were terminated by sharp and jagged points. They rose in one unbroken sweep from the water's edge, and were covered to the height of fourteen or fifteen hundred feet by the dusky-coloured forest. It was most curious to observe, how level and truly horizontal the line on the mountain side was, as far as the eye could range, at which trees ceased to grow. It precisely resembled the high-water mark of drift weed on a sea-beach.

At night we slept close to the junction of Ponsonby Sound with the Beagle channel. A small family of Fuegians, who were living in the cove, were very quiet and inoffensive, and soon joined our party round the blazing fire. We were well clothed, and though sitting close to the fire, were far from too warm; yet these naked savages, though further off, were observed to our great surprise, to be streaming with perspiration at undergoing such a roasting. They seemed, however, very well pleased, and all joined in the chorus of the seamen's songs: but the manner in which they were invariably a little behindhand was quite ludicrous.

During the night the news had spread, and early in the morning (23d) a fresh party arrived. Several of them had run so fast that their noses were bleeding, and their mouths frothed from the rapidity with which they talked, and with their naked bodies all bedaubed with black, white, and red, they looked like so many demoniacs who had been fighting. We then proceeded down Ponsonby Sound to the spot

where poor Jemmy expected to find his mother and relations. We staid there five days. Captain FitzRoy has given an account of all the interesting events which there happened.

During the succeeding year we paid another visit to the Fuegians, and the Beagle herself followed the same course which I have just described as having been taken in the boats. I was amused by finding what a difference the circumstance of being quite superior in force made, in the interest of beholding these savages. While in the boats I got to hate the very sound of their voices, so much trouble did they give us. The first and last word was "yammerschooner." When, entering some quiet little cove, we have looked round and thought to pass a quiet night, the odious word "yammerschooner" has shrilly sounded from some gloomy nook, and then the little signal smoke has curled upwards to spread the news. On leaving some place we have said to each other, "Thank Heaven, we have at last fairly left these wretches!" when one more faint halloo from an all-powerful voice, heard at a prodigious distance, would reach our ears, and clearly could we distinguish—"yammerschooner." But on the latter occasion, the more Fuegians the merrier; and very merry work it was. Both parties laughing, wondering, gaping at each other; we pitying them, for giving us good fish and crabs for rags, &c.; they grasping at the chance of finding people so foolish as to exchange such splendid ornaments for a good supper. It was most amusing to see the undisguised smile of satisfaction with which one young woman, with her face painted black, tied with rushes several bits of scarlet cloth round her head. Her husband, who enjoyed the very universal privilege in this country of possessing two wives, evidently became jealous of all the attention paid to his young wife; and, after a consultation with his naked beauties, was paddled away by them.

Some of the Fuegians plainly showed that they had a fair idea of barter. I gave one man a large nail (a most valuable present) without making any signs for a return; but he immediately picked out two fish, and handed them up on the

point of his spear. If any present was designed for one canoe, and it fell near another, it was invariably given to the right owner. We were always much surprised at the little notice, or rather none whatever, which was evinced respecting many things, even such as boats, the use of which must have been evident. Simple circumstances,—such as the whiteness of our skins, the beauty of scarlet cloth or blue beads, the absence of women, our care in washing ourselves,—excited their admiration far more than any grand or complicated object, such as the ship. Bougainville has remarked concerning these very people that they treat the "chef d'œuvres de l'industrie humaine, comme ils traitent les loix de la nature et ses phénomènes."

The perfect equality among the individuals composing these tribes, must for a long time retard their civilization. As we see those animals, whose instinct compels them to live in society and obey a chief, are most capable of improvement, so is it with the races of mankind. Whether we look at it as a cause or a consequence, the more civilized always have the most artificial governments. For instance, the inhabitants of Otaheite, who, when first discovered, were governed by hereditary kings, had arrived at a far higher grade than another branch of the same people, the New Zealanders,—who although benefited by being compelled to turn their attention to agriculture, were republicans in the most absolute sense. In Tierra del Fuego, until some chief shall arise with power sufficient to secure any acquired advantages, such as the domesticated animals or other valuable presents, it seems scarcely possible that the political state of the country can be improved. At present, even a piece of cloth is torn into shreds and distributed; and no one individual becomes richer than another. On the other hand, it is difficult to understand how a chief can arise till there is property of some sort by which he might manifest and still increase his authority.

January 28th.—In the evening, Captain FitzRoy sent two boats back to the ship from Ponsonby Sound, and with

the two others proceeded to survey the western end of the Beagle channel. The view in this central part was very remarkable. Looking towards either hand, no object intercepted the vanishing points of this long canal of the mountains. The circumstance of its being an arm of the sea was rendered very evident by several huge whales spouting in different directions. On one occasion I saw two of these monsters, probably male and female, slowly swimming one after the other, within less than a stone's throw of the shore, over which the beech extended its branches.

We sailed on till it was dark, and then pitched our tents in a quiet creek. The greatest luxury here is to find a beach of pebbles, for they are both dry and yield to the body. The peaty soil is damp; rock is uneven and hard; sand gets into one's meat, when cooked and eaten boat-fashion; but when lying in our blanket bags, on a good bed of smooth pebbles, we passed most comfortable nights.

It was my watch till one o'clock. There is something very solemn in these scenes. At no time does the consciousness in what a remote corner of the world you are then buried, come so strongly before your mind. Every thing tends to this effect; the stillness of the night is interrupted only by the heavy breathing of the seamen beneath the tents, and sometimes by the cry of a night bird. The occasional barking also of a dog, heard in the distance, reminds one that it is the land of the savage.

29TH.—Early in the morning we arrived at the point where the Beagle channel divides itself into two arms; and we entered the northern one. The scenery here becomes even grander than before. The lofty mountains on the north side compose the granitic axis, or backbone of the whole country. They were covered by a wide mantle of perpetual snow, and numerous cascades poured their waters, through the woods, into the narrow channel below. In many parts magnificent glaciers extended from the mountain side to the water's edge. It is scarcely possible to imagine any thing more beautiful than the beryl-like blue of the glacier, and especially when

contrasted with the dead white of an expanse of snow. As fragments fell from the glacier into the water, they floated away, and the channel with its icebergs represented in miniature the polar sea. When we reached the western mouth of this branch of the channel, we sailed amongst many unknown islands, and then proceeded by the outer coast to the entrance of the other arm. Thence we returned to Ponsonby Sound, saw the Fuegians, and arrived at the ship after our twenty-days' excursion.

CHAPTER XII.

Falkland Islands—Excursion round island—Aspect—Cattle, horses, rabbit, wolf-like fox—Fire made of bones—Art in making fire—Manner of hunting wild cattle—Geology, fossil shells—Valleys filled with great fragments, scenes of violence—Penguin—Geese—Eggs of doris—Zoophytes, coralline phosphorescent—Compound animals.

FALKLAND ISLANDS.

March 16th, 1834.—The Beagle anchored in Berkeley Sound, in East Falkland Island.* This archipelago is situated in nearly the same latitude as the mouth of the Strait of Magellan. It covers a space of about 120 by 60 geographical miles, and is a little more than half the size of Ireland. After the possession of these miserable islands had been contested by France, Spain, and England, they were left uninhabited. The government of Buenos Ayres then sold them to a private individual, but likewise used them, as old Spain had done before, for a penal settlement. England claimed her right and seized them. The Englishman who was left in charge of the flag was consequently murdered. A British officer was next sent, unsupported by any power: and when we arrived, we found him in charge of a population, of which rather more than half were runaway rebels and murderers.

The theatre is worthy of the scenes acted on it. An undulating land, with a desolate and wretched aspect, is every where covered by a peaty soil and wiry grass, of one monotonous brown colour. Here and there a peak or ridge of gray quartz rock, breaks through the smooth surface. Every one has heard of the climate of these regions; it may be compared to that which is experienced at the height of between one and two thousand feet, on the mountains of North

* In the same month, also, of the previous year, the Beagle visited these islands.

Wales; having however less sunshine and less frost, but more wind and rain.

March 16th.—I will now describe a short excursion which I made round a part of this island. In the morning I started with six horses and two Gauchos: the latter were capital men for the purpose, and well accustomed to living on their own resources. The weather was very boisterous and cold, with heavy hailstorms. We got on, however, pretty well; but excepting in the geology, nothing could be less interesting than our day's ride. The country is uniformly the same undulating moorland; the surface being covered by light brown withered grass and a few very small shrubs, all springing out of an elastic peaty soil. In the valleys here and there might be seen a small flock of wild geese, and every where the ground was so soft, that the snipe was able to feed. Besides these two kinds of birds, there were few others. There is one main range of hills, nearly two thousand feet in height, and composed of quartz rock, the rugged and barren crests of which gave us some trouble to cross. On the south side we came to the best country for wild cattle; we met however no great number, for they had lately been much harassed.

In the evening we came across a small herd. One of my companions, St. Jago by name, soon separated a fat cow; he threw the bolas, and it struck her legs, but failed in becoming entangled. Then dropping his hat to mark the spot where the balls were left, while at full gallop he uncoiled his lazo, and after a most severe chase, again came up to the cow, and caught her round the horns. The other Gaucho had gone on ahead with the horses, so that 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. But when on level ground it does not appear an easy job for one man to kill a beast mad with terror. Nor would it be so, if

the horse, when left to itself without its rider, did not soon learn, for its own safety, to keep the lazo tight; so that, if the animal moves forward, the horse moves just as quickly so much away; otherwise, it stands motionless leaning on one side. This horse, however, was a young one, and would not stand still, but gave in to the cow as she struggled. It was admirable to see with what dexterity St. Jago dodged behind the beast, till at last he contrived to give the fatal touch to the main tendon of the hind leg; after which, driving his knife into the head of the spinal marrow, the cow dropped as if struck by lightning. He cut off pieces of flesh with the skin to it, but without any bones, sufficient for our expedition. We then rode on to our sleeping-place, and had for supper "carne con cuero," or meat roasted with the skin on it. This is as superior to common beef, as venison is to mutton. A large circular piece 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. If any worthy alderman had supped with us that evening, "carne con cuero," without doubt, would soon have been celebrated in London.

During the night it rained, and the next day (17th) was very stormy, with much hail and snow. We rode across the island to the neck of land which joins the Rincon del Toro (the great peninsula at the S.W. extremity) to the rest of the island. From the greater number of cows which have been killed, there is a large proportion of bulls. These wander about by twos and threes, or by themselves, and are very savage. I never saw such magnificent beasts; they truly resembled the ancient sculptures, in which the size of the neck and head is but seldom equalled among tame animals. The young bulls ran away for a short distance, but the old ones did not stir a step, except to rush at man and horse; and many of the latter have thus been killed. One old bull crossed a boggy stream, and took up his stand on the opposite side to us. We in vain tried to drive him away, and failing, were obliged to make a large circuit. The Gauchos in revenge

determined to render him for the future innocuous. It was very interesting to see how art completely mastered force. One lazo was thrown over his horns, as he rushed at the horse, and another round his hind legs: in a minute the monster was stretched harmless on the ground. After the lazo has once been tightly drawn round the horns of a furious animal, it does not at first appear an easy thing to disengage it again; nor, I apprehend, would it be so, if the man was by himself, and he did not wish to kill the beast. By the aid, however, of a second person throwing his lazo, so as to catch both hind legs, it is quickly managed: for the animal, as long as its hind legs are kept outstretched, is quite powerless, and the first man can with his hands loosen his lazo, and then quietly mount his horse; but the moment the second man, by backing ever so little, relaxes the strain, the lazo slips off the legs of the struggling beast, which thus rises free, shakes himself, and vainly rushes after his antagonist.

During our whole ride we only saw one troop of wild horses. These animals, as well as the cattle, were introduced by the French in 1764, since which time they have greatly increased. It is a curious fact, that the horses have never left the eastern end of the island, although there is no natural boundary to prevent them from roaming, and that part of the island is not more tempting than the rest. The Gauchos, though asserting this to be the case, are unable to account for the circumstance. The horses appear to thrive well, yet they are small sized, and have lost so much strength, that they are unfit to be used in taking wild cattle with the lazo. In consequence, it is necessary to go to the great expense of importing fresh horses from the Plata. At some future period the southern hemisphere probably will have its breed of Falkland ponies, as the northern has that of Shetland.

The rabbit is another animal which has been introduced, and has succeeded very well; so that they abound over large parts of the island. Yet, like the horses, they are confined

within certain limits; for they have not crossed the central chain of hills; nor would they have extended even so far as the base, if, as the Gauchos informed me, small colonies had not been carried there. I should not have supposed that these animals, natives of northern Africa, could have existed in a climate so extremely humid as this, and which enjoys so little sunshine that even wheat ripens only occasionally. It is asserted that in Sweden, which any one would have thought a more favourable climate, the rabbit cannot live out of doors. The first few pair moreover had here to contend against pre-existing enemies, in the fox, and some large hawks. The French naturalists have considered the black variety a distinct species, and called it *Lepus Magellanicus*.* They imagined that Magellan, when talking of an animal under the name of "conejos," in the Strait of Magellan, referred to this species; but he was alluding to a small cavy, which to this day is thus called. The Gauchos laughed at the idea of the black kind being different from the gray, and they said that at all events it had not extended its range any further than the other; that the two were never found separate; and that they readily bred together, and produced piebald offspring. Of the latter I now possess a specimen, and it is marked about the head, differently from the French specific description. This circumstance shows how cautious naturalists should be in making species; for even Cuvier, on looking at the skull of one of these rabbits, thought it was probably distinct.

The only quadruped native to the island, is a large wolf-like fox,† which is common to both East and West Falkland. I

* Lesson's Zoology of the Voyage of the Coquille, vol. i., p. 168. All the early voyagers, and especially Bougainville, distinctly state that the wolf-like fox was the only native animal on the island. The distinction of this rabbit as a species, is taken from peculiarities in the fur, from the shape of the head, and from the shortness of the ears. I may here observe that the difference between the Irish and English hare, rests upon nearly similar characters, only more strongly marked.

† I have reason to believe there is likewise a field-mouse. The com-

have no doubt it is a peculiar species, and confined to this archipelago; because many sealers, Gauchos, and Indians, who have visited these islands, all maintain that no such animal is found in any part of South America. Molina, from a similarity in habits, thought this was the same with his "culpeu;"* but I have seen both, and they are quite distinct. These wolves are well known, from Byron's account of their tameness and curiosity; which the sailors, who ran into the water to avoid them, mistook for fierceness. To this day their manners remain the same. They have been observed to enter a tent, and actually pull some meat from beneath the head of a sleeping seaman. The Gauchos, also, have frequently killed them in the evening, by holding out a piece of meat in one hand, and in the other a knife ready to stick them. As far as I am aware, there is no other instance in any part of the world, of so small a mass of broken land, distant from a continent, possessing so large a quadruped peculiar to itself. Their numbers have rapidly decreased; they are already banished from that half of the island which lies to the eastward of the neck of land between St. Salvador Bay and Berkeley Sound. Within a very few years after these islands shall have become regularly settled, in all probability this fox will be classed with the dodo, as an animal which has perished from the face of the earth. Mr. Lowe, an intelligent person who has long been acquainted with these islands, assured me, that all the foxes from the western island were smaller and of a redder colour than those from the eastern. In the four specimens which were brought to England in the Beagle† there was some variation, but the difference with respect to

mon European rat and mouse have roamed from the habitations, and have settled themselves at various points. The common hog has also run wild.

* The "culpeu" is the *Vulpes Magellanicus* brought home by Captain King from the Strait of Magellan. It is common in Chile.

† Captain FitzRoy has presented two of these foxes to the British Museum, where Mr. Gray had the kindness to compare them in my presence.

the islands could not be perceived. At the same time the fact is far from improbable.

At night (17th) we slept on the neck of land which forms the south-west peninsula. The valley was pretty well sheltered from the cold wind; but there was very little brushwood for fuel. The Gauchos, however, soon found what, to my great surprise, made nearly as hot a fire as coals; this was the skeleton of a bullock lately killed, from which the flesh had been picked by the Caracaras. They told me that in winter they had often killed a beast, cleaned the flesh from the bones with their knives, and then with these same bones roasted the meat for their suppers.

18TH.—It rained during nearly the whole day. At night we managed, however, with our saddle-cloths, to keep ourselves pretty well dry and warm; but the ground on which we slept was on each occasion nearly in the state of a bog, and there was not a dry spot to sit down on after our day's ride. I have in another part stated how singular it is that trees should be entirely absent from these islands, while they cover the whole surface of Tierra del Fuego. The largest bush in the island (belonging to the family of Compositæ) is scarcely so tall as our gorze. The best fuel is afforded by a green little bush, about the size of common heath, which has the useful property of burning while fresh and green. It was very surprising to see the Gauchos, in the midst of rain, and every thing soaking wet, with nothing more than a tinder-box and piece of rag, immediately make a fire. They sought beneath the tufts of grass and bushes for a few dry twigs, and these they rubbed into fibres; then surrounding them with coarser twigs, something like a bird's nest, they put the rag with its spark of fire in the middle, and covered it up. The nest being then held up to the wind, by degrees it smoked more and more, and at last burst out in flames. I do not think any other method would have had a chance of succeeding with such damp materials.

19TH.—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 almost lived on horseback, say that, under similar circumstances, they always suffer. St. Jago told me, that having been confined for three months by illness, he went out hunting wild cattle, and in consequence, for the next two days, his thighs were so stiff that he was obliged to lie in bed. This shows that the Gauchos, although they do not appear to do so, yet really must exert much muscular effort in riding. The hunting wild cattle, in a country so difficult to pass as this is on account of the swampy ground, must be very hard work. The Gauchos say they often pass at full speed over ground which would be impassable at a slower pace; in the same manner as a man is able to skate across thin ice. When hunting, the party endeavours to get as close as possible to the herd without being discovered. Each man carries four or five pair of the bolas; these he throws one after the other at as many cattle, which, when once entangled, are left for some days, till they become a little exhausted by hunger and struggling. They are then let free and driven towards a small herd of tame animals, which have been brought to the spot on purpose. From their previous treatment, being too much terrified to leave the herd, they are easily driven, if their strength lasts out, to the settlement.

The weather continued so very bad, that we determined to make a push, and try to reach the vessel before night. From the quantity of rain which had fallen, the surface of the whole country was swampy. I suppose my horse fell at least a dozen times, and sometimes the whole six were floundering in the mud together. All the little streams are bordered by soft peat, which makes it very difficult for the horses to leap them without falling. To complete our discomforts, we were obliged to cross the head of a creek, in which the water was as high as the backs of the horses, and the little waves, owing to the violence of the wind, broke over us, and made us very wet and cold. Even the iron-framed Gauchos professed themselves glad when they reached the settlement, after our little excursion.

The geological structure of these islands is in most respects simple. The lower country consists of clay-slate and sandstone associated together, and the hills of white granular quartz rock. The strata of the latter are frequently arched with perfect symmetry, and the appearance of some of the masses is in consequence most singular. Pernety* has devoted several pages to the description of a hill of ruins, the successive strata of which he has justly compared to the seats of an amphitheatre. The quartz rock must have been quite pasty when it underwent such remarkable flexure without being shattered into fragments. As a passage between the quartz and the sandstone can be traced, it seems probable that the former owes its origin to the sandstone having been heated to such an excess, that it became viscid, and upon cooling crystallized. While in the soft state it must have been pushed up through the overlying beds.

The sandstone and clay-slate contain numerous casts of organic remains. These chiefly consist of shells allied to terebratula, of encrinites, of a branching coral divided into alternate compartments, and lastly, of an obscure impression of the lobes of a trilobite. These fossils possess great interest, because none hitherto have been brought to Europe from a latitude nearly so far south. Mr. Murchison, who had the kindness to look at my specimens, says that they have a close general resemblance to those belonging to the lower division of his Silurian system; and Mr. James Sowerby is of opinion that some of the species are identical. This would be a most remarkable circumstance in the ancient natural history of the world; for shells now living in latitude 50° on opposite sides of the equator, are totally distinct. From the similarity of the Falkland fossils with those in England which are associated with remains that indicate a climate of a tropical character, we may I presume infer that, during this same epoch, nearly the whole world was thus circumstanced.

* Pernety, Voyage aux Isles Malouines, p. 526.

In many parts of the island, the bottoms of the valleys are covered in an extraordinary manner, by myriads of great angular fragments of the quartz rock. These have been mentioned with surprise by every voyager since the time of Pernety. The whole may be called "a stream of stones." The blocks vary in size, from that of a man's chest to ten or twenty times as large, and occasionally they altogether exceed such measures. Their edges show no signs of being water-worn, but are only a little blunted. They do not occur thrown together in irregular piles, but are spread out into level sheets, or great streams. It is not possible to ascertain their thickness, but the water of small streamlets could be heard trickling through the stones many feet below the surface. The actual depth is probably much greater, because the crevices between the lower fragments must long ago have been filled up with sand, and the bed of the rivulet thus raised. The width of these beds varies from a few hundred feet to a mile; but the peaty soil daily encroaches on the borders, and even forms islets wherever a few fragments happen to lie close together. In a valley south of Berkeley Sound, which some of our party called the "great valley of fragments," it was necessary to cross an uninterrupted band half a mile wide, by jumping from one pointed stone to another. So large were the fragments, that being overtaken by a shower of rain, I readily found good shelter beneath one of them.

Their little inclination is the most remarkable circumstance in these "streams of stones." On the hill-sides I have seen them sloping at an angle of ten degrees with the horizon; but in some of the level, broad-bottomed valleys, the inclination is only just sufficient to be clearly perceived. On so rugged a surface there was no means of measuring the angle; but to give a common illustration, I may say that the slope alone would not have checked the speed of an English mail-coach. In some places, a continuous stream of these fragments followed up the course of a valley, and even extended to the very crest of the hill. On these

crests huge masses, exceeding in dimensions any small building, seemed to stand arrested in their headlong course: there, also, the curved strata of the archways lay piled over each other, like the ruins of some vast and ancient cathedral. In endeavouring to describe these scenes of violence, one is tempted to pass from one simile to another. We may imagine, that streams of white lava had flowed from many parts of the mountains into the lower country, and that, when consolidated, they had been rent by some enormous convulsion into myriads of fragments. The expression, "streams of stones," which immediately occurred to every one, conveyed the same idea. These scenes are, on the spot, rendered more striking, by the contrast of the low, rounded forms of the neighbouring hills.

I was much interested by finding on the highest peak of one range (about 700 feet above the sea) a great arched fragment, lying on its convex or upper surface. Must we believe that it was fairly pitched up in the air, and thus turned? Or, with more probability, that there existed formerly a part of the same range more elevated than the point on which this monument of a great convulsion of nature now lies. As the fragments in the valleys are neither rounded nor the crevices filled up with sand, we must infer that the period of violence was subsequent to the land having been raised above the waters of the sea. In a transverse section within these valleys the bottom is nearly level, or rises but very little towards either side. Hence the fragments appear to have travelled from the head of the valley; but in reality it seems most probable, either that they have been hurled down from the nearest slopes, or that masses of rock were broken up in the position they formerly occupied; and that since, by a vibratory movement of overwhelming force,* the

* "Nous n'avons pas été moins saisis d'étonnement à la vûe de l'innombrable quantité de pierres de toutes grandeurs, bouleversées les unes sur les autres, et cependant rangées, comme si elles avoient été amoncelées négligemment pour remplir des ravins. On ne se lassoit pas d'admirer les effets prodigieux de la nature."—*Pernety*, p. 526.

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 (like so much sand on a vibrating board), to move onwards and find their level? I have seen, in the Cordillera of the Andes, the evident marks where stupendous mountains have been broken into pieces like so much thin crust, and the strata thrown on their vertical edges; but never did any scene, like the "streams of stones," so forcibly convey to my mind the idea of a convulsion of which in historical records we might in vain seek for any counterpart.

I have little to remark on the zoology of these islands. I have before described the Polyborus or Caracara. There are some other hawks, owls, and a few small land-birds. The waterfowl† are particularly numerous, and they must formerly, from the accounts of old navigators, have been much more so. One day, having placed myself between a penguin (*Aptenodytes demersa*) and the water, I was much amused by watching its habits. It was a brave bird; and till reaching the sea, it regularly fought and drove me backwards. Nothing less than heavy blows would have stopped him; every inch gained he firmly kept, standing close before me, erect and determined. When thus opposed he continually rolled his head from side to side, in a very odd manner, as if the power of distinct vision only lay in the anterior and

* An inhabitant of Mendoza, and hence well capable of judging, assured me that, during the several years he had resided on these islands, he had never felt the slightest shock of an earthquake.

† I may mention, that I one day observed a cormorant playing with a fish which it had caught. Eight times successively the bird let its prey go, then dived after it, and although in deep water, brought it each time to the surface. In the Zoological Gardens I have seen the otter treat a fish in the same manner, much as a cat does a mouse. I do not know of any other instance where dame Nature appears so wilfully cruel.

basal part of each eye. This bird is commonly called the jackass penguin, from its habit, while on shore, of throwing its head backwards, and making a loud strange noise, very like the braying of that animal; but while at sea, and undisturbed, its note is very deep and solemn, and is often heard in the night-time. In diving, its little plumeless wings are used as fins; but on the land, as front legs. When crawling (it may be said on four legs) through the tussocks, or on the side of a grassy cliff, it moved so very quickly that it might readily have been mistaken for a quadruped. When at sea and fishing, it comes to the surface, for the purpose of breathing, with such a spring, and dives again so instantaneously, that I defy any one at first sight to be sure that it is not a fish leaping for sport.

Two kinds of geese frequent the Falklands. The upland species (*Anas leucoptera*) is common in pairs, and in small flocks, throughout the island. They do not migrate, but build on the small outlying islets. This is supposed to be from fear of the foxes: and it is perhaps from the same cause that these birds, though very tame by day, are shy and wild in the dusk of the evening. They live entirely on vegetable matter. The rock-goose, so called from living exclusively on the sea-beach (*Anas antarctica*), is common both here and on the west coast of America, as far north as Chile. In the deep and retired channels of Tierra del Fuego, the snow-white gander, invariably accompanied by his darker consort, and standing close by each other on some distant rocky point, is a common feature in the landscape.

In these islands a great loggerheaded duck or goose (*Anas brachyptera*), which sometimes weighs twenty-two pounds, is very abundant. These birds were in former days called, from their extraordinary manner of paddling and splashing upon the water, race-horses; but now they are named, much more appropriately, steamers. Their wings are too small and weak to allow of flight, but by their aid, partly swimming and partly flapping the surface of the water, they move very quickly. The manner is something like that by which the common house-

duck escapes when pursued by a dog; but I am nearly sure that the steamer moves its wings alternately, instead of both together, as in other birds. These clumsy, loggerheaded ducks make such a noise and splashing, that the effect is exceedingly curious.

Thus we find in South America three birds, which use their wings for other purposes besides flight: the penguin as fins, the steamer as paddles, and the ostrich as sails to a vessel. The steamer is able to dive only a very short distance. It feeds entirely on shell-fish from the kelp and tidal rocks; hence the beak and head, for the purpose of breaking them, are surprisingly heavy and strong. So strong is the head, that I have scarcely been able to fracture it with my geological hammer; and all our sportsmen soon discovered how tenacious these birds were of life. When pluming themselves in the evening in a flock, they make the same odd mixture of sounds which bullfrogs do within the Tropics.

In Tierra del Fuego, as well as at the Falkland Islands, I made many observations on the lower marine animals,* but they are of little general interest. I will only mention one class of facts, relating to certain zoophytes in the more highly organized division of that class. Several genera (*flustra, eschara, cellaria, crisia,* and others) agree in having singular

* While at the Falklands, during the autumn of the southern hemisphere, most of the lower marine animals were breeding. I was surprised to find on counting the eggs of a large white Doris (this sea-slug was three and a half inches long) how extraordinarily numerous they were. From two to five eggs (each three-thousandths of an inch in diameter) were contained in a spherical little case. These were arranged two deep in transverse rows forming a ribbon. The ribbon adhered by its edge to the rock in an oval spire. One, which I found, measured nearly twenty inches in length and half in breadth. By counting how many balls were contained in a tenth of an inch in the row, and how many rows in an equal length of the ribbon, on the most moderate computation there were six hundred thousand eggs. Yet this Doris was certainly not very common: although I was often searching under the stones I saw only seven individuals.

moveable organs, like those of *Flustra avicularia* (found in the European seas), attached to their cells. The organ, in the greater number of cases, very closely resembles the head of a vulture; but the lower mandible can be opened much wider, so as to form even a straight line with the upper. The head itself possesses considerable powers of movement, by means of a short neck. In one zoophyte the head itself was fixed, but the lower jaw free: in another it was replaced by a triangular hood, with a beautifully-fitted trap-door, which evidently answered to the lower mandible. A species of stony eschara had a structure somewhat similar. In the greater number of species, each shell was provided with one head, but in others each had two.

The young cells at the end of the branches necessarily contained quite immature polypi, yet the vulture-heads attached to them, though small, were in every respect perfect. When the polypus was removed by a needle from any of the cells, these organs did not appear in the least affected. When one of the latter was cut off from a cell, the lower mandible retained its power of opening and closing. Perhaps the most singular part of their structure is, that when there were more rows of cells than two, both in a Flustra and an Eschara, the central cells were furnished with these appendages, of only one-fourth the size of the lateral ones. Their movements varied according to the species:—in some I never saw the least motion; while others, with the lower mandible generally wide open, oscillated backwards and forwards at the rate of about five seconds each turn; others moved rapidly and by starts. When touched with a needle the beak generally seized the point so firmly, that the whole branch might be shaken.

These bodies have no relation whatever with the production of the gemmules. I could not trace any connexion between them and the polypus. From their formation being completed before that of the latter; from the independence of their movements; from the difference of their size in different parts of the branch; I have little doubt that in their

functions they are related rather to the axis than to any of the polypi. In a similar manner, the fleshy appendage at the extremity of the sea-pen forms part of the zoophyte as a whole, as much as the roots of a tree do of the whole and not of the individual buds. Without doubt this is a very curious variation in the structure of a zoophyte: for the growing part in most other cases does not manifest the least irritability or power of movement.

I will mention one other kind of structure quite as anomalous. A small and elegant Crisia is furnished, at the corner of each cell, with a long and slightly-curved bristle, which is fixed at the lower end by a joint. It terminates in the finest point, and has its outer or convex side serrated with delicate teeth or notches. Having placed a *small* piece of a branch under the microscope, I was exceedingly surprised to see it suddenly start from the field of vision by the movement of these bristles, which acted as oars. Irritation generally produced this motion, but not always. When the coralline was laid flat on that side from which the toothed bristles projected, they were necessarily all pressed together and entangled. This scarcely ever failed to excite a considerable movement among them, and evidently with the object of freeing themselves. In a small piece, which was taken out of water and placed on blotting-paper, the movement of these organs was clearly visible for a few seconds by the naked eye.

In the case of the vulture-heads, as well as in that of the bristles, all that were on one side of a branch, moved sometimes coinstantaneously, sometimes in regular order one after the other; at other times the organs on both sides the branch moved together; but generally all were independent of each other, and entirely so of the polypi. In the Crisia, if the bristles were excited to move by irritation in any one branch, generally the whole zoophyte was affected. In the instance where the branch started from the simultaneous movement of these appendages, we see as perfect a transmission of will as in a single animal. The case, indeed, is not different from

that of the sea-pen, which when touched drew itself into the sand. I will state one other instance of uniform action, though of a very different nature, in a zoophyte* closely allied to Clytia, and therefore very simply organized. Having kept a large tuft of it in a basin of salt water, when it was dark I found that as often as I rubbed any part of a branch, the whole became strongly phosphorescent with a green light: I do not think I ever saw any object more beautifully so. But the remarkable circumstance was, that the flashes of light always proceeded up the branches, from the base towards the extremities.

The examination of these compound animals was always very interesting to me. What can be more remarkable than to see a plant-like body producing an egg, furnished with setæ, and having independent movements, which soon becomes fixed, branches into numberless arms, and these, though crowded with polypi, yet in some cases possessing independent organs of movement, and obeying uniform impulses of will? The polypi are frequently animals of no simple organization; and in most respects certainly are to be considered as true individuals. It is therefore more curious to observe, in the young and terminal cells, their gradual formation, from the growth of the simple horny substance of which so many zoophytes are composed. The known organization of a tree should remove all surprise at the union of many individuals together, and their relation to a common body. Indeed we might expect, according to the apparent law, that any structure which prevails in one class will be produced in a lesser degree in some others—that since so many plants are compound, so would some animals be thus constructed. It requires, however, a greater effort of reason to view a bud as an individual, than a polypus furnished with a mouth and intestines; and therefore the union does not appear so strange.

* This coralline emitted a very strong and disagreeable odour, when freshly taken from the sea.

Our conception of a compound animal,* where in some respects the individuality of each is not completed, may be aided, by reflecting on the production of two distinct creatures by bisecting one with a knife, or where nature herself performs the task. We may consider the polypi in a zoophyte, or the buds in a tree, as cases where the division of the individual has not been completely effected. In this kind of generation, the individuals seem produced only with relation to the present time; their numbers are multiplied, but their life is not extended beyond a fixed period. By the other, and more artificial kind, through intermediate steps or ovules, the relation is kept up through successive ages. By the latter method many peculiarities, which are transmitted by the former, are obliterated, and the character of the species is limited; while on the other hand, certain peculiarities (doubtless adaptations) become hereditary and form races. We may fancy that in these two circumstances we see a step towards the final cause of the shortness of life.

* With regard to associated life, animals of other classes besides the mollusca and radiata present obscure instances of it. The bee could not live by itself. And in the neuter, we see an individual produced which is not fitted for the reproduction of its kind—that highest point at which the organization of all animals, especially the lower ones, tends—therefore such neuters are born as much for the good of the community, as the leaf-bud is for the tree.

CHAPTER XIII.

Strait of Magellan—Port Famine—Geology—Deep water in channels—Erratic boulders—Climate—Limit of fruit trees—Mean temperature—Luxuriant forests—Rigour of antarctic islands—Contrast with the north — Snow-line, great flexure of—Glaciers — Icebergs transport fragments of rock — Glacier in low latitude — Absence of erratic blocks in intertropical regions — Glaciers and tropical vegetation —Comparison with northern hemisphere—Siberian animals in ice—Embedded in cold mud—Edible fungus—Zoology—Fucus giganteus—Leave Tierra del Fuego.

STRAIT OF MAGELLAN.

In the end of May, 1834, we entered for the second time the eastern mouth of the Strait of Magellan. Having beat our way against wind and wave we anchored at Gregory Bay, and had an interview with the so-called gigantic Patagonians; of whom Captain FitzRoy has given so good an account. The country on both sides of the strait, in this part, consists of level plains, like those of the rest of Patagonia. Cape Negro, a little past the second narrow, may be considered as the point where the land begins to assume the marked features of Tierra del Fuego. On the east coast, south of the Strait, broken park-like scenery in a like manner connects these two countries, which are opposed to each other in almost every point. It is truly surprising to find in a space of twenty miles such a change in the landscape. If we take rather a greater distance, as between Port Famine and Gregory Bay, that is about sixty miles, the difference is still more wonderful. At the former place we have rounded mountains concealed by impervious forests, which are drenched with the rain, brought by an endless succession of gales; while at Cape Gregory there is a clear and bright blue sky over the dry and sterile plains. The atmospheric cur-

rents,* although rapid, turbulent, and unconfined by any apparent limits, yet seem to follow, like a river in its bed, a regularly determined course.

June 1st.—We anchored in the fine bay of Port Famine. It was now the beginning of winter, and I never saw a more cheerless prospect; the dusky woods piebald with snow, could be only indistinctly seen through a drizzling hazy atmosphere. We were, however, lucky in getting two fine days. On one of these, Mount Sarmiento, a distant mountain 6800 feet high, presented a very noble spectacle. I was frequently surprised, in the scenery of Tierra del Fuego, at the little apparent elevation of mountains really lofty. I suspect it is owing to a cause, which would not at first be imagined, namely, that the whole mass, from the summit to the water's edge, is generally in full view. I remember having seen a mountain, first from the Beagle channel, where the whole sweep from the summit to the base was full in view, and then from Ponsonby Sound across several successive ridges; and it was curious to observe in the latter case, as each fresh step afforded means of judging of the distance, how the mountain appeared to rise in height.

The Fuegians twice came and plagued us. As there were many instruments, clothes, and men on shore, it was thought necessary to frighten them away. The first time, a few great guns were fired, when they were far distant. It was most ludicrous to watch through a glass the Indians, as often as the shot struck the water, take up stones, and as a bold defiance, throw them towards the ship, though about a mile and a half distant! A boat was then sent with orders to fire a few musket-shot wide of them. The Fuegians hid them-

* The south-westerly breezes are generally very dry. January 29th, being at anchor under Cape Gregory; a very hard gale from W. by S., clear sky with few cumili; temperature 57°, due point 36°, difference 21°. On January 15th, at Port St. Julian: in the morning light winds with much rain, followed by a very heavy squall with rain,—settled into heavy gale with large cumili,—cleared up, blowing very strong from SSW. Temperature 60°, due point 42°,—differnece 18°.

selves behind the trees; and for every discharge of the musket they fired their arrows: all, however, fell short of the boat, and the officer as he pointed at them laughed. This made the Fuegians frantic with passion, and they shook their mantles in vain rage. At last seeing the balls cut and strike the trees, they ran away; and we were left in peace and quietness.

On a former occasion, when the Beagle was here in the month of February, I started one morning at four o'clock to ascend Mount Tarn, which is 2600 feet high, and is the most elevated point in this immediate neighbourhood. We went in a boat to the foot of the mountain (but not to the best part), and then began our ascent. The forest commences at the line of high-water mark, and during the two first hours I gave over all hopes of reaching the summit. So thick was the wood, that it was necessary to have constant recourse to the compass; for every landmark, though in a mountainous country, was completely shut out. In the deep ravines, the death-like scene of desolation exceeded all description; outside it was blowing a gale, but in these hollows, not even a breath of wind stirred the leaves of the tallest trees. So gloomy, cold, and wet was every part, that not even the fungi, mosses, or ferns, could flourish. In the valleys it was scarcely possible to crawl along, they were so completely barricaded by the great mouldering trunks, which had fallen down in every direction. When passing over these natural bridges, one's course was often arrested by sinking knee deep into the rotten wood; at other times, when attempting to lean against a firm tree, one was startled by finding a mass of decayed matter ready to fall at the slightest touch. We at last found ourselves among the stunted trees, and then soon reached the bare ridge, which conducted us to the summit. Here was a view characteristic of Tierra del Fuego;—irregular chains of hills, mottled with patches of snow, deep yellowish-green valleys, and arms of the sea intersecting the land in many directions. The strong wind was piercingly cold, and the atmosphere rather hazy, so that we did not stay

long on the top of the mountain. Our descent was not quite so laborious as our ascent; for the weight of the body forced a passage, and all the slips and falls were in the right direction.

Captain King has given a sketch of the geology of Tierra del Fuego, to which I have little to add. A great formation of clay-slate, rarely containing organic remains, but sometimes presenting casts of a kind of ammonite, is fronted on the east side by plains belonging probably to two tertiary epochs. On the west coast, a prolongation of the grand crevice of the Andes, from which so much heat has escaped from the interior of the globe, has metamorphosed the slate. There is, however, a double line, the structure of which I do not quite comprehend. The interior one consists of granite and mica slate; the exterior one (perhaps more modern), of greenstone, porphyritic and other curious trappean rocks. Almost every one at first thinks that this country owes its grand name of "the Land of Fire," to the number of its volcanoes. Such, however, is not the case: I did not see even a pebble of any volcanic rock, except in Wollaston Island, where some rounded masses of scoriæ were embedded in a conglomerate of no modern date. In a geological point of view this circumstance allows us to consider the grand linear train of ancient and modern volcanoes, which fall on parallel fissures in the Andes, as extending from lat. 55° 40′ south to 60° north, a distance little less than seven thousand geographical miles.

Perhaps the most curious feature in the geology of this country, is the extent to which the land is intersected by arms of the sea. These channels, as Captain King remarks, are irregular and dotted with islands, where the granitic and trappean rocks occur, but in the clay-slate formation are so straight, that in one instance "a parallel ruler placed on the map upon the projecting points of the south shore, extended across, also touched the headlands of the opposite coast."

I have heard Captain FitzRoy remark, that on entering any of these channels from the outer coast, it is always ne-

cessary to look out directly for anchorage; for further inland the depth soon becomes extremely great. Captain Cook, in entering Christmas Sound, had first 37 fathom, then 40, 60, and, immediately afterwards, no soundings with 170. This structure of the bottom, I presume, must arise from the sediment deposited near the mouths of the channels, by the opposed tides and swell; and likewise from the enormous degradation of the coast rocks, caused by an ocean harassed by endless gales.

The Strait of Magellan is extremely deep in most parts, even close to the shore. About mid-channel eastward of Cape Froward, Captain King found no bottom with 1536 feet: if, therefore, the water should be drained off, Tierra del Fuego would present a far more lofty range of mountains than it does at present. I will not here enter on any speculations regarding the causes which have produced this remarkable structure, in a district in which the latter movements at least have been those of elevation. I may, however, observe, that pebbles, and great boulders of various and peculiar crystalline rocks, which have undoubtedly travelled from the south-west coast, lie scattered over the whole of the eastern part of Tierra del Fuego. One enormous block of syenite near St. Sebastian Bay was barn-shaped, and had a girth of 47 feet; it projected five feet above the sand, and appeared to be deeply buried. The very nearest point to which we can look for the parent rock, is about ninety miles distant. On the shores of the Strait of Magellan, near Port Famine, numerous semi-rounded fragments of various granites and hornblendic rocks are strewed on the beach, and on the sides of the mountain, to an elevation of thirty or forty feet. Now to this point the high road from the Southern and Western shores passes directly over the great abyss of more than 1500 feet deep. Whatever may have been the means of transport, it has not been one of indiscriminate violence: for the two places, St. Sebastian Bay and Shoal Harbour, where the great fragments are most numerous, certainly existed previously to the last and

smallest change of level, as channels connecting the Strait of Magellan, in the one case with the open sea, and in the other with Otway Water.

The climate of the southern part of South America presents many phenomena of the highest interest. It has long been observed that there exists some essential difference between it, and that of the countries in the northern hemisphere. I have already remarked on the surprising contrast between the rank vegetation of the broken west coast, consequent on the humid climate, as compared with the dry and sterile plains of Patagonia. The clouded and boisterous state of the atmosphere is necessarily accompanied by a decrease in extreme temperature; hence we find that fruits which ripen well, and are very abundant, such as the grape and fig, in lat. 41° on the east coast, succeed very poorly in a lower latitude on the opposite side of the continent.* The result is more strongly marked, if we take Europe as the standard of comparison. In Chiloe, lat. 42°, corresponding to the northern parts of Spain, peaches require the greatest care, and seldom produce fruit; but strawberries and apples succeed to admiration. At Valdivia, lat. 40°, or that of Madrid, standard peaches bear abundantly; grapes and figs ripen, but are far from common; olives seldom even partially ripen, and oranges not at all; yet in Europe this is the parallel most productive of these fruits. Even at Concepcion, lat. 36°, oranges are not abundant, though the other named fruits succeed perfectly. At the Falklands, in the same latitude as the south of England, wheat very seldom comes to maturity; but we ought to feel little surprise at this, when we hear that in Chiloe (lat. 42°) the inhabitants are frequently compelled to cut their corn before it is ready, and bring it into their houses to dry.

With respect to the climate of Tierra del Fuego during

* As there are no settlements on the Patagonian coast, there are few means of comparison. Cherry-trees left by the Spaniards at Port Desire, lat. 48°, still bear fruit, whereas, in Chiloe, on the west coast, 360 miles further north, I believe they do not succeed.

the colder parts of the year, Captain King has published some most interesting tables in the Geographical Journal.* The Beagle during this voyage, was employed in the extreme southern parts of the country, from December 18th to February 20th. From the appearance of the vegetation during the first part, and from the weather we experienced at the Falkland Islands, subsequent to the last date, I feel little doubt that these sixty-five days included the best part of the summer. Perhaps if another fortnight had been added, the mean would have been a little higher. The first eighteen of these days were spent partly at sea, near Cape Horn, and we were drifted for a short time by bad weather to nearly ninety miles to the southward. The mean temperature, from observations made every two hours by the officers on board the Beagle, was 45°. During the succeeding thirty-seven days† the Beagle was at anchor in different harbours a few leagues north of Cape Horn, and then the mean from observations at 6 A.M., noon, and 6 P.M., was 50°. The mean, therefore, between these two periods, which include the hottest part of the year, is only 47°.5. The latter of the two periods was unusually warm, but the former much the contrary, and the station where the observations were made was a little further to the southward. The whole of these observations apply to the extreme islands: Captain King's were made in a central position 1° 45′ further northward. If from the above considerations we add two degrees and a half to the mean obtained this voyage, the result (50°) will probably give the temperature of the hottest part of the year in central Tierra del Fuego. Captain King gives as the mean temperature of June 32°.97, of July 33°.03, of the first twelve days in August 33°.25;

* Journal of the Royal Geographical Society for the years 1830, 1831.

† The mean of the maxima of these thirty-seven days was only 55°.5, and of the minima 45°.3,—the mean range thus being 10°.2. For the whole sixty-five days, the mean of the maxima was only 51°.7, which certainly is a very wretched summer, and shows how little bright sunshine there can be.

answering to our December, January, and February, which three months appear to be the coldest, and the mean of these is 33°.08.* Dublin is nearly in the same latitude in the northern hemisphere as Port Famine is in the southern, and we will take its temperature as a means of comparison.

	Latitudes.	Summer Temperature.	Winter Temperature	Difference.	Mean of Summer and Winter.
Dublin† . . .	53° 21′ N.	59° .54	39° .2	20° .34	49° .37
Port Famine .	53 38′ S.	50	33 .08	16 .92	41 .54
Difference .	0 17′	9 .54	6 .12	3 .42	7 .83

It will be seen by this that the temperature at Port Famine is very considerably lower, both during summer and winter, than at Dublin, and that at the former the difference between the seasons is not so great, or that the climate is there more equable. It seems the general opinion of those who have visited this country, that the frosts are not so severe or so long as in England. The sealers say that throughout the year they wear the same quantity of clothing. Nevertheless Captain King states, that during the winter of 1828 the temperature was once as low as‡ 12°.6. I have drawn up these rough and approximate statements merely for the sake of illustrating some of the following remarks.

* This mean must be a little too low, because the whole of August is not included. I see Von Buch says, "we can hardly assign to Saltenfiord, Norway (in lat. 67°, or 13° 22′ nearer the pole than Port Famine) a higher mean temperature than 34°, nor a higher temperature for the warm month of July than 57°.8." (Travels through Norway, p. 123.) Captain King gives as the mean for February, which probably is the hottest month at Port Famine, only at 51°.1. Some observations made at the Falkland Islands (2° 13′ north of Port Famine) which are often quoted, give as the mean for the whole year 47°.3, and for the summer 53°.1. These results are very much higher than what I should have anticipated, from the climate of the neighbouring mainland.

† This line is taken from Barton's Lectures on the Geography of Plants.

‡ In this wretched climate, subject to such extreme cold, is it not most wonderful, that human beings should be able to exist unclothed and without shelter?

The kind of climate here described appears to be common to the *southern* parts of the whole of the southern hemisphere. Although so inhospitable to our feelings, and to most of the plants from the warmer parts of Europe, yet it is most favourable to the native vegetation. The forests, which cover the entire country between the latitudes of 38° and 45°, rival in luxuriance those of the glowing intertropical regions. Whilst in Chiloe (lat. 42°) I could almost have fancied myself in Brazil. Stately trees of many kinds, with smooth and highly coloured barks, are loaded by parasitical plants of the monocotyledonous structure; large and elegant ferns are numerous; and arborescent grasses intwine the trees into one entangled mass, to the height of thirty or forty feet above the ground. Palm-trees grow in lat. 37°; an arborescent grass very like a bamboo in 40°; and another closely-allied kind, of great length but not erect, even as far south as 45°.

In another part of this same hemisphere, which has so uniform a character owing to its large proportional area of sea, Forster found parasitical orchideous plants living south of lat. 45° in New Zealand. Tree-ferns thrive luxuriantly near Hobart Town, in Van Diemen's Land. I measured one there which was exactly six feet in circumference; and its height from the ground to the base of the fronds appeared to be very little under twenty. Mr. Brown says* "an arborescent species of the same genus (*Dicksonia*) was found by Forster, in New Zealand, at Dusky Bay, in nearly 46° S., the highest latitude in which tree-ferns have yet been observed. It is remarkable that, although they have so considerable a range in the southern hemisphere, no tree-fern has been found beyond the northern tropic: a distribution in the two hemispheres somewhat similar to this has been already noticed respecting the Orchideæ that are parasitical on trees."

Even in Tierra del Fuego, Captain King describes the "vegetation thriving most luxuriantly, and large woody stem-

* Appendix to Flinder's Voyage, pp. 575 and 584.

med trees of Fuchsia and Veronica, in England considered and treated as tender plants, in full flower, within a very short distance of the base of a mountain covered for two-thirds down with snow, and with the temperature at 36°." He states, also, that humming-birds were seen sipping the sweets of the flowers, "after two or three days of constant rain, snow, and sleet, during which time the thermometer had been at the freezing point." I myself have seen parrots feeding on the seeds of the winter's bark, south of latitude 55°.

Although the limit of an almost tropical vegetation extends thus far southward, yet the dearth of living things, both vegetable and animal, on the islands situated even far without the antarctic circle, is surprising, compared with the corresponding parallels in the northern hemisphere. In South Shetland in lat. 62° to 63° (same as Ferroe, or southern part of Norway) Weddell* states, "None of the islands afford any vegetation save a short straggling grass, which is found in very small patches in places where there happens to be a little soil. This, together with a moss similar to that which is found in Iceland, appears in the middle of January, at which time the islands are partially clear of snow." In Deception Island, one of the same group, Lieutenant Kendall, says,† "There was nothing in the shape of vegetation except a small kind of lichen." The island itself is partly composed of ice and volcanic ashes interstratified. Another curious proof of the rigour of the climate is mentioned: "Having observed a mound on the hill immediately above this cove, I opened it, and found a rude coffin, the rotten state of which bespoke its having been long consigned to the earth; but the body had undergone scarcely any decomposition. The legs were doubled up, and it was dressed in the jacket and cap of a sailor, but neither they nor the countenance were similar to those of an Englishman."

Sandwich Land, which is nearly three degrees further from

* Weddell's Voyage, p. 133.

† Geographical Journal, 1830, pp. 65 and 66.

the pole, is thus described by Captain Cook (February 1st, hottest time in the year, and in same latitude as north of Scotland): "Every part was blocked or filled up with ice, and the whole country, from the summits of the mountains down to the very brink of the cliffs which terminate the coast, covered many fathoms thick with everlasting snow. The cliffs alone were all which was to be seen like land." Again he adds, talking of two islets, "These only were clear of snow, and seemed covered with a green turf." In Georgia, lat. 54° to 55°, the bays are terminated by ice cliffs of considerable height, and, according to Cook, the country "in the very height of summer, is in a manner wholly covered many fathoms deep with frozen snow, but more especially on the south-west coast." The only vegetable is "a strong-bladed grass growing in tufts, wild burnet, and a plant like moss." Although 96 miles long and about ten broad, it possesses not a single quadruped, and only one land bird, namely a small titlark (an Anthus), a specimen of which I procured in the Falklands. This bird, if undescribed, certainly well deserves the name of *antarcticus*, for although not living within that circle, it inhabits a more inhospitable region than any other terrestrial animal. Anderson, in Cook's Voyage, says, even in Kerguelen Land (an island 120 miles long by 60 broad, and situated in lat. 50°, corresponding to the extreme southern point of England), "The whole catalogue of plants does not exceed sixteen or seventeen, including some sorts of moss, and a beautiful species of lichen which grows upon the rocks higher up than the rest of the vegetable productions. Nor is there even the least appearance of a shrub in the whole country." It is doubtful whether there is a single land bird; and then he adds, "The hills are of a moderate height; yet many of their tops were covered with snow* at this time, though answering to our June." These statements forcibly prove the intemperance of the climate even far without the frozen limits of the antarctic circle.

* I have reason to believe, that icebergs are formed on the coast during a part of the year.

There are no direct observations, by which to judge of the mean temperature of the year in these southern islands. But after reading the above accounts, it will readily be granted that it must be very low. Even in Georgia, in lat. 54°-55°, it is not improbable that the soil is perpetually frozen at a few feet beneath the surface. At Deception Island in lat. 62°-63° from the preservation of the dead body alluded to, and the interstratification of ice with the volcanic ashes, we may feel almost sure that such must be the case. In the northern hemisphere, it is only on the great continents that so low a mean temperature is found in corresponding latitudes. In North America, according to Richardson,* north of lat. 56°, the thaw does not penetrate to a greater depth than three feet. In the Steppes of Siberia, Humboldt† states that to the northward of 62°, the ground between twelve and fifteen feet below the surface is always frozen. In the space, however, between these two great northern continents, the line of perpetual congelation rises considerably towards the north.

It is a remarkable meteorological fact, that in the northern and southern hemispheres, a low mean temperature, in latitudes without the frigid zone, is the result of a directly opposite condition of things. In the northern hemisphere the atmosphere is rendered extremely cold, from the radiation of a large extent of country during a long winter; nor is it moderated by the warmer currents of any neighbouring sea: hence the extreme cold of the winter more than counterbalances the heat of summer. In the southern hemisphere, on the other hand, although the winter is moderate, the summer is cold; for a sky constantly clouded rarely permits the rays of the sun to warm the surface (itself a bad absorbent) of the great ocean: hence, the mean temperature of the year falls below the freezing point. It will at once be evident, that a kind of vegetation which requires an equable temperature, will approach much nearer

* Appendix to Back's Expedition.

† Fragmens Asiatiques, vol. ii., p. 386.

the line of perpetual congelation in a climate such as this of the southern hemisphere, than in the opposite one subject to extremes.

The height of the plane of perpetual snow in any country, seems chiefly to be determined by the extreme heat of summer, rather than by the mean of the year. As the summer in Tierra del Fuego is so very wretched, we ought not to feel surprised at the fact stated by Capt. King, —that in the Strait of Magellan, the line descends to about 3500 or 4000 feet. In the northern hemisphere, we must travel about fourteen degrees nearer the pole to meet with so low a limit, namely, between lat. 67° and 70° on the mountains of Norway.

In the Cordillera of South America, between latitudes 41° and 43° 30′, the culminant peaks have altitudes pretty nearly equal. Several were measured by the officers of the Beagle with considerable care, by angles of elevation, the positions of the mountains being accurately known. Osorno is 7550 feet; mountain south of Osorno 5609; Minchinmadiva 7046; northern end of same range 6862; Corcovado 7510; Yntales 6725. Not only these points, but a great part of the range* was thickly clothed with snow, in the beginning of February (answering to our August), which descended some way down the mountains, and presented to a distant beholder a perfectly horizontal line. We were assured that the snow, which it appeared must inevitably be the case, remained throughout the year. On January 26th, after a week of uncommonly fine weather, Mr. King measured with a pocket sextant, the angle of this line with the summit of the Corcovado; and subtracting the result from the total height, the snow-line was found to descend to 4480 feet. It is possible that there may have existed some unknown cause of error; but as the average height of the few *highest*

* Mr. Sulivan, who surveyed this part of Chiloe, informs me, that between Osorno and Yntales, there are probably many mountains which rise to a height of nearly 6000 feet. He says he does not recollect any one summit, which (during January) was not covered with snow.

peaks in the *snow-clad range* is under 7000 feet, it is evident that the height of the snow-line cannot at most much exceed 6000 feet.

As this is a point of interest, I shall mention a few other circumstances, by which I think we may come to a nearly definite conclusion. On February 2d (1835) I obtained the last view of the Cordillera; on that day the lower line of the snow descended some way (so as to form a considerable angle with the summit, when viewed from a distance of 61 miles) on the mountain south of Osorno (lat. 41° 20′), which stands by itself, and has a height of 5607 feet. Since arriving in England I have received a letter from Mr. Douglas in Chiloe, who, describing some volcanic phenomena, accidentally mentions the snow-line. He says, on February 20th (same year), on the volcano of Minchinmadiva (lat. 42° 48′), which has an elevation of 7046 feet, lava was ejected from a crater "just above the verge of the snow." Again, on February 27th, he alludes to the summit of the Corcovado (7510 feet) being covered with snow, as was Yntales* (6725 feet) in lat. 43° 30′. Again Mr. Douglas, speaking of the Corcovado, says, "On the 16th of March the snow appeared to cover one-fifth of its (*visible*) perpendicular height." By this date the snow-line must have attained its greatest height (if, indeed, fresh snow had not fallen); and, as the Corcovado rises in an unbroken slope close to the sea, the proportion covered by snow might be judged of, with *some* degree of accuracy. The height of the Corcovado (7510 feet) was obtained by three angular measurements, made by the officers on the survey, and the mean nearly agreed with the three separate results. Reflecting on all these circumstances, we may conclude with perfect safety, that the limit of perpetual snow, between the latitudes 41° and 43°, cannot much, if at all, exceed 6000 feet.

Proceeding northward along the Cordillera we find a very

* On January 15th, Yntales, seen from the Northern Chonos Islands, was entirely covered by snow.

different condition of things. In the pass of the Portillo (to the southward of 33°) Dr. Gillies determined barometrically the height of the double range; and he found the two ridges to be respectively 13,210 and 14,365 feet. On March 21st and 22d (1835), shortly before fresh snow fell, I crossed these mountains,* and although there were large masses of snow, there were much greater spaces at some height on each side uncovered. Dr. Gillies† says, "the summit (of the volcano of Peuquenes) is generally‡ covered with snow, and its elevation cannot be less than 15,000 above the level of the sea." From these statements, compared with my observations, the snow-line when I crossed certainly was considerably above 14,365,—we may assume 15,000 as about the limit. From the results obtained by Humboldt, Pentland, Gillies, and King, we are enabled to draw up the following table of the extraordinary range of the snow-line on the Cordillera of South America:

Latitude.	Height in feet of Snow-line.	Observer.
Equatorial region: Mean result.	15,748	Humboldt.
Bolivia, Lat. 16°-18° S.	17,000	Pentland.§
Central Chile, Lat. 33° S.	14,500 to 15,000	Gillies.
Chiloe, Lat. 41°-43° S.	6,000	Officers of the Beagle.
Tierra del Fuego, 54° S.	3,500 to 4,000	King.‖

* I crossed the Uspallata Pass on April 5th. The height, as given by Mr. Pentland (Geographical Journal), is 12,454. In the ravines there were some inconsiderable patches of snow, but the general surface was quite bare.

† The Edinburgh Journal of Natural and Geographical Science, August, 1830, p. 316.

‡ I have reason to suspect that the snow-line in Chile is subject to ex-

In considering this table, and beginning from the south, we observe, that through the first twelve degrees, the height of the snow-line rises only a little more than 2000 feet. In this space the climate and productions of the country are in many respects very uniform. In the succeeding nine degrees the rise is no less than nine thousand feet. Before any one pronounces this to be impossible, let him reflect well that the height of the snow-line very much depends on the heat of summer. In Chiloe no fruit, excepting apples and strawberries, comes to perfection; it is even oftentimes necessary to carry the barley and corn into the houses to be ripened:* on the other hand, in central Chile, even the sugar-cane† has been cultivated out of doors, and during a long summer of seven months the sky is seldom clouded, and rain never falls. The island of Chiloe, as well as the neighbouring main-

treme variation. I was told, that during one remarkably dry and long summer, all the snow disappeared from Aconcagua. Not being at the time aware of the extraordinary elevation of this mountain (23,000), I did not closely cross-question my informers. It must be remembered that even in ordinary summers the sky is generally cloudless for six or seven months, that no fresh snow falls, and that the atmosphere is excessively dry. It may be asked whether vast quantities of snow would not, under this condition of circumstances, be evaporated? so that it might be *possible* that all the snow should disappear from a mountain without the temperature having risen above the freezing point. Mr. Miers (vol. i., p. 384) says he passed the Cordillera by the Cumbre Pass on May 30th, 1819, "when not the smallest vestige of snow was observable in any part of the Andes." Yet Aconcagua is in full view in the approach to this pass. Mr. Miers, in another part (p. 383), makes a general assertion to the same effect.

§ See Mr. Pentland's most interesting paper in the Geograph. Journal, read March 1835.

|| Journal of Geograph. Soc., vol. i., p. 165.

* For this fact I may quote, as additional authority, Aguerros Descripcion Historial de la Provincia de Chiloé, 1791, p. 94.

† Miers's Chile, vol. i., p. 415. It is said that the sugar-cane grew at Ingenio, lat. 32°-33°, but not in sufficient quantity to make the manufacture profitable. In the valley of Quillota, south of Ingenio, I saw some large date palm-trees.

land, is concealed by one dense forest, dripping with moisture, and abounding with ferns and other plants that love a humid atmosphere: while the soil of central Chile, where not irrigated, is arid and nearly desert. These two countries, so remarkably opposed to each other in every character, blend together rather suddenly near Concepcion, in lat. 37°. I do not doubt, the plain of perpetual snow undergoes an extraordinary flexure in the district where the forest ceases; for trees indicate a rainy climate, and hence a clouded state of atmosphere.*

From central Chile to Bolivia, a space of 16°, the rise of the snow-line is only 2000 feet. If Bolivia possessed an atmosphere as clear as that of Chile, the limit in all probability would be even higher than the present 17,000. The cause why the limit in the equatorial regions should be lower than in a latitude seventeen degrees to the southward, I leave to those to explain, who have more means of information respecting the dryness and clouded state of the atmosphere in the respective regions.

The presence of glaciers depends on the accumulation of a large mass of snow, subject to some variations of temperature, sufficient partially to thaw, and then reconsolidate the

* The average degree of atmospheric transparency seems to be a most important element in determining the climate of any place. Dr. Richardson (Report to Brit. Assoc. for 1836, p. 131) has remarked that Professor Leslie, from experimenting on the effects of radiation only in an insular climate, deduced theoretical inferences respecting the mean temperature of the year, extremely different from the results obtained under the clear atmosphere of the polar regions. I apprehend central Chile will bear comparison with any part of the world for the clearness of its sky, and Chiloe, for one of an opposite condition: therefore we should not feel surprised, if the effects of two such opposite climates at first appear and malous. The remarkable difference in the height of the snow-line, on the opposite sides of the Himmalaya, has been explained by Humboldt and Jacquemont, on the same principle: and in a like manner, the difference between the heights on the Pyrenees and on Caucasus, the latter mountains being characterized by a climate more excessive, than that of the former.

mass in its downward course. They have been aptly compared to gigantic icicles. The lower limit of glaciers, must depend on that of the parent snow, greatly affected by the form of the land: in Tierra del Fuego the snow-line descends very low, and the mountain sides are abrupt; therefore we might expect to find glaciers extending far down their flanks.* Nevertheless, when on first beholding, in the middle of summer, many of the creeks on the northern side of the Beagle channel terminated by bold precipices of ice overhanging the salt water, I felt greatly astonished. For the mountains from which they descended, were far from being very lofty. Captain FitzRoy from angular measurements considers the general range to have an elevation rather under 4000 feet, with one point called Chain Mountain rising to 4300. Further inland, there is indeed a more lofty mountain of 7000 feet, but it is not directly connected with the glaciers to which I now allude. This range, which exceeds by so little the height of some mountains in Britain, which yet sends down in the middle of summer its frozen streams to the sea-coast, is situated in the latitude of the Cumberland hills.

I was much interested by observing the great difference between the matter brought down by torrents and by glaciers. In the former case a spit of gravel is formed, but in the latter a pile of boulders. On one occasion, the boats being hauled on shore, within the distance of half a mile from a glacier, we were admiring the perpendicular cliff of blue ice, and wishing that some more fragments would fall off, like those we saw floating on the water, at a distance of more than a mile from their source. At last, down came a mass

* In the Alps, Saussure gives 8793 feet as the mean of the lower limit of the snow-line. At Mont Blanc the glacier of Montanvert is said (Encyclo. Metropol.) to descend 12,000 feet below the summit of the mountain, and this will make its base 5160 feet lower than the line of snow. In Norway (See Von Buch) where a glacier first comes down to the water's edge (lat. 67°), it is 3800 below the same line: in Tierra del Fuego the difference must be very nearly the same as in the last case.

with a roaring noise, and immediately we saw the smooth outline of a wave travelling towards us. The men ran down as quickly as they could to the boats; for the chance of their being dashed to pieces was evident. One of the seamen just caught hold of the bows, as the curling breaker reached it: he was knocked over and over but not hurt; and the boats, though thrice lifted on high and let fall again, received no damage. This was most fortunate for us, for we were a hundred miles distant from the ship, and we should have been left without provisions or fire-arms.

I had previously observed that some large fragments of rock on the beach had been lately displaced: but until seeing this wave I did not understand the cause. The structure of the creek in which this happened was very curious. One side was formed by a spur of mica slate (of which rock the surrounding mountains were composed); the head by a cliff of ice about forty feet high; and the other side by a promontory which was built up of huge rounded fragments of granite and mica slate, and was more than fifty feet in height. To account for the present position of these blocks, where they must have long remained, for old trees were growing on the upper parts; we must suppose, either that the glacier formerly advanced half a mile further outward, or that the land stood at a rather different level. Whether we are able fully to account, or not, for the height and size of this promontory of boulders, certainly it must have been the work of the glacier. One semi-rounded fragment of granite lying just above high-water mark, was of enormous dimensions. It projected six feet above the sand, and was buried to an unknown depth: its shape was oval with a circumference of thirty yards, so that the longer axis probably measured about ten or eleven. This fragment must have come from the higher parts of the range; for the base of the mountain was entirely composed of mica slate.

The waves caused by the fall of the ice must be a most powerful agent in rounding and heaping together these huge fragments, and likewise in wearing away projecting points of

the solid rock. In Georgia, situated in the very same latitude, Cook, speaking of the great ice-cliffs at the head of every harbour, says, "pieces were continually breaking off, and floating out to sea, and a great fall happened while we were in the bay, which made a noise like cannon." He adds, "It can hardly be doubted, that a great deal of ice is formed here in winter, which in the spring is broken off, and dispersed over the sea. Mr. Sorrell, the boatswain of the Beagle, who has long been accustomed to these seas, informs me, that at this season he has seen small icebergs, with mud and gravel on them, floating from the shores. I have heard from another quarter of the same circumstance. Captain Hunter* says, he met numerous ice-islands in this neighbourhood, and that "many were half black apparently with earth from the land, to which they had adhered, or else with mud from the bottom on which they had been formed." By the latter method large fragments might easily be transported, and unless the iceberg should be upset, they would never be discovered. Nevertheless, the islands of ice floating in the southern ocean, and especially those occurring far south, appear generally to be quite free from all impurities excepting the dung of seafowl. Captain Biscoe, who extended his enterprising researches so far towards the antarctic pole, informs me in a letter that he never observed in a single instance† any mud or fragments of stone on the numerous icebergs which he encountered during his voyage.

Glaciers occur at the head of the sounds along the whole western coast of the southern part of South America. Looking at the chart I find sixteen places mentioned: besides these I know of several others, such as those in the Beagle channel and at the foot of Mount Sarmiento. The sounds, moreover, were not all traced to the head, and it is in this part that the glaciers most frequently occur. Of the sixteen referred to, many include several frozen arms coming down

* Hunter's Voyage to Port Jackson, p. 102.

† Mr. Sorrell says, that he once saw an iceberg to the eastward of South Shetland, with a considerable block of rock lying on it.

from one vast body of ice. In the Canal of the Mountains, for instance, no less than nine descend from a mountain, the whole side of which, according to the chart, is covered by a glacier of the extraordinary length of twenty-one miles, and with an average breadth of a mile and a half. It must not be supposed that the glacier merely ascends some valley for the twenty-one miles, but it extends apparently at the same height for that length, parallel to the sound; and here and there sends down an arm to the sea-coast.* There are other glaciers having a similar structure and position, with a length of ten and fifteen miles.

I will now specify a few of the more remarkable cases, taken from Captain King's paper, to which I have so often referred. The canal of St. Andrew is said by Lieutenant Skyring to be "suddenly and boldly closed by tremendous and astonishing glaciers." The highest mountain in this part (Mount Stokes) was ascertained during our ascent of the river of St. Cruz to be 6200 feet, and this certainly exceeds considerably the height of the general range. About ninety miles to the northward, Sir G. Eyre's Sound, in the latitude of Paris, has its several arms terminated by glaciers. Mr. Bynoe, the surgeon of the Beagle, who accompanied the boat when this part was surveyed, informs me that about mid-channel, and more than *twenty* miles from the head of the sound, there were great numbers of floating masses of ice. Standing in the boat he supposes he saw about fifty: he, together with four of the boat's crew, landed on one, which although only two or three feet above the surface of the water, felt quite steady, and easily supported their weight. On the surface, in the central part, a mass of granite, of an angular form, was partly embedded; and the

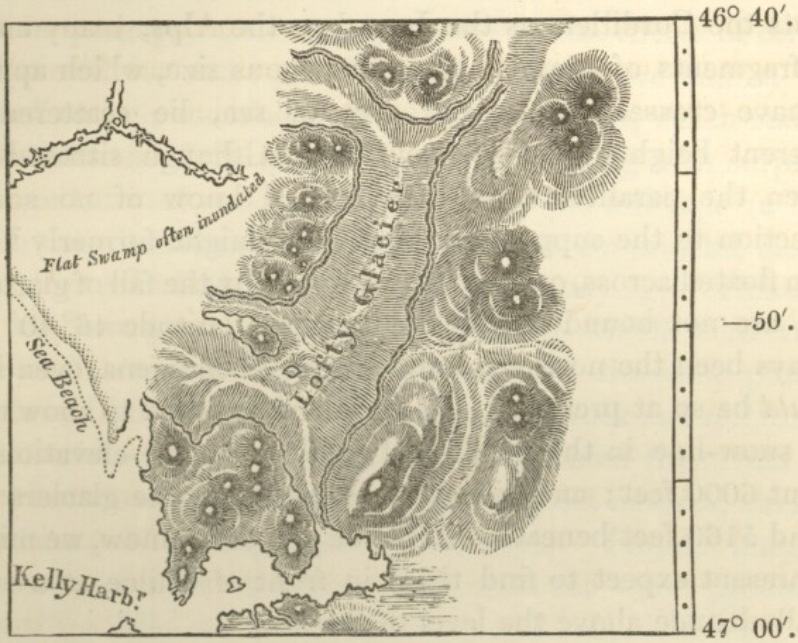
* I may remark that in the chart, the greater number of the creeks which receive the glaciers, have crosses drawn in front, which signify projecting masses of rock. After what we have seen in the Beagle channel, I suspect that they are detached masses brought down by the overwhelming force of the glaciers.

ice had thawed all round it, so as to form a shallow pool of water. It was a cube of nearly two feet; and Mr. Bynoe with a maul knocked off, and brought away, a piece as large as a man's head. The iceberg was still floating, and drifting outwards: even if it had been stranded in the immediate neighbourhood, the block of granite would have rested on the clay-slate of the surrounding mountains. For the parent rock we must look to the higher parts of the range, near the head of the sound.

Again, a few miles to the northward I see in the chart an *Iceberg* Sound, which no doubt was so called from the number of floating masses of ice. It may be recollected that in this latitude, on the opposite side of the Cordillera, the plains of St. Cruz, at the distance of fifty and sixty miles from the mountains, were strewed with great fragments of rock. Of these, one was sixty feet in circumference, and another, which was angular, measured five yards square;—both being partly buried in the gravel, so that their thickness was unknown. As it is probable that the plains were covered by the sea within a period geologically recent, and as we absolutely know, that icebergs at the present day, both in the same latitude and even further northward, are transporting angular blocks from the opposite side of the Cordillera, the explanation of the St. Cruz case through the same means of transport, is rendered so evidently probable, that we are not justified in doubting to receive it: more especially as the unbroken surface of those plains, and the terrace-formed valley, opposes a very great difficulty to the admission of any violent debacle. The latitudes which we have now been talking of, correspond to the southern extremity of Cornwall, and the northern provinces of France.

I will add only one other case; namely, the occurrence of glaciers at the level of the sea, in the gulf of Penas, latitude 46° 40′. A glacier is represented in the charts as in one part abutting on *a flat swamp often inundated*, and in ano-

ther reaching to the head of Kelly Harbour. The accompanying wood-cut is copied from the published charts.



Captain King says its length is fifteen miles, and from the chart one part is seven broad; it is also described as being lofty; so that we here have an enormous mountain, covering a wide area, composed of ice. If we compare its situation with countries in the northern hemisphere, the corresponding parallel crosses the Alps of Switzerland. Or we may state the case stronger, by saying that glaciers here descend to the sea within less than nine degrees of latitude, from where palms grow, less than two and a half from arborescent grasses, and (looking to the westward in the same hemisphere) less than two from orchideous parasites, and within a single degree of tree-ferns! In Norway, Von Buch found glaciers descending to the sea at Kunnen in latitude 67°; that is twenty degrees nearer the pole, than in this hemisphere;—a difference of latitude rather greater than that between the snow-lines of equal altitude in the same two countries.

The survey of the *inner* coast terminated at the gulf of Penas, so that I am far from knowing whether glaciers are not

found much further northward: and considering the immense size of the one just described, it is extremely improbable that it should be the last. On the island of Chiloe, which fronts the Cordillera as the Jura does the Alps, many angular fragments of granite, of an enormous size, which appear to have crossed the inland arm of sea, lie scattered at different heights over the country. Although situated between the parallels of 41° and 43°, I know of no sound objection to the supposition that these might formerly have been floated across, on icebergs produced by the fall of glaciers. We are not bound to suppose that the latitude 46° 40′ has always been the northern limit of such phenomena, even if it *should* be so at present. We have endeavoured to show that the snow-line in the parallel of Chiloe has an elevation of about 6000 feet; and since on Mont Blanc the glaciers descend 5160 feet beneath the line of perpetual snow, we might at present expect to find them in front of Chiloe at a very small altitude above the level of the sea.

With respect to the position of the glaciers, they seem to occur only within the deep sounds which penetrate the central Cordillera. This may be attributed chiefly to the subordinate elevation of the outer lines. When we consider the vast dimensions and number of these glaciers, the effect produced on the land must be very great. Every one has heard of the mass of rubbish propelled by the glaciers of Switzerland, as they slowly creep onwards. In the same manner in Tierra del Fuego, on a still night the cracking and groaning of the great moving mass may be distinctly heard. The same force, which is known to uproot whole forests of lofty trees, must, when grating over the surface, tear from the flanks of the mountain many huge fragments of rock. Beneath each glacier, also, a roaring torrent drains the upper part of the ice. To these effects, which are common to all cases, there must be added, in this country, the wear and tear of the waves produced by each successive fall. Nor can this agency be inconsiderable, when we remember that it goes on night and day, century after century. We must look

at every portion of the mountain as having, during the gradual rising of the land, been successively exposed to the action of these combined forces.

It is, perhaps, useless to speculate on the effects of earthquakes without some positive data. But as we find in the immediate neighbourhood of that great glacier, which stands in the latitude of the Alps, Byron* mentioning with surprise the quantities of sea-shells lying on all the hill-tops (a fact which may be taken as a proof of recent continental elevations); and Bulkeley,† in his narrative, saying, "This day we felt four great earthquakes, three of which were very terrible;" we may feel well assured, that the same power, which in Chile causes such vast masses of rock and soil to fall from the sea-cliffs, has oftentimes precipitated fragments far more immense, of a mass traversed by great fissures, already in motion, and resting on an inclined plane. I cannot imagine any scene of more terrific violence, than the waves produced by such a fall: we know that they are very bad from the mere oscillation, consequent on the movements of the ground; but in this case I can readily believe that the water would be fairly beaten back out of the deepest inlet, and then returning with an overwhelming force, would whirl about rocks of vast size like so much chaff.

In after ages, with a climate modified by the process of such physical changes as are now going on throughout the greater part of this continent, the effects which had been produced by these glaciers would appear inexplicable, to a person who doubted the possibility of their occurrence in such latitudes. He would see in the most retired and protected valleys (the present channels) beaches composed of great rounded boulders, such as those heaped up on the shore of the most turbulent ocean. Then perhaps he would speculate, either that the outer chain of mountains had been elevated

* Byron's Narrative of the Shipwreck of the Wager.

† Bulkeley's and Cummin's Faithful Narrative of the loss of the Wager. The earthquake happened August 25, 1741.

subsequently to the interior ones, so as to protect a coast hitherto exposed, or that overwhelming deluges had swept down the valleys, and in some manner produced, in one day, the effects of attrition which on ordinary occasions require the prolonged action of centuries.

If we could at the present day submerge the greater part of Tierra del Fuego, or leave unelevated that which we know has recently been gained, an island with a few small outliers would be formed, similar to Georgia, and situated in exactly the same latitude. Have we in such case the slightest right to deny the probability that the snow-line would descend nearly to the water's edge, and that every valley would be "terminated by a wall of ice," and that "in winter masses would be broken off and dispersed over the sea?"—all of which circumstances are now happening in Georgia. The currents, which always set from the westward towards the east, would drift these floating masses through the channels towards the eastern side. And as we know that icebergs at the present day, in both hemispheres, occasionally transport fragments of rock, so we cannot deny that those of Tierra del Fuego might formerly have done so. When the land was elevated, the fragments of rock would be found deposited on the eastern side of the continent, in bands representing the ancient channels. Whether or not the hypothesis of their transport be true, such is the position of the erratic blocks in Tierra del Fuego.

With respect to the general theory of the transport by great fragments of ice, especially of such as are angular, I may add a few remarks. Humboldt having observed that none occurred over the vast intertropical plains of the eastern side of South America, believed that they were entirely absent from the whole continent. As far as I am able to discover from the works of travellers, and from what I have myself seen, the remark holds good in the countries on both sides of the Cordillera as far south as central Chile. Azara has particularly stated such to be the case in Chaco. With respect to the tributaries of the Amazons, nothing can more

strongly prove it than La Condamine's* story. He says, "Below Borja even for four or five hundred leagues, a stone, even a single flint, is as great a rarity as a diamond would be. The savages of those countries don't know what a stone is, and have not even a notion of it. It is diversion enough to see some of them when they come to Borja, and first meet with stones, express their admiration at them with signs, and be eager to pick them up, loading themselves therewith as with a valuable merchandise." It is therefore a remarkable circumstance that as soon as we reach the colder latitudes in the southern hemisphere (from 41° to Cape Horn), the same phenomenon occurs, almost on as grand a scale and with similar limits, as in the northern parts both of the Old and New World. Neither in the southern nor in the northern hemisphere do the fragments, coming from the polar regions, or from other mountain groups, arrive within a considerable distance of the lines of the tropics.

We must couple the absence of erratic blocks along that part of the Andes which is situated under a warmer climate, with the similar non-occurrence, as I am informed by Professor Royle, in Northern India round the flanks of the Himmalaya;—those loftiest pinnacles on the face of the globe. With regard to Southern Africa, from lat. 35° to the tropic, Dr. Andrew Smith, who has visited as a naturalist so large a portion of the interior, assures me he has never seen any thing of the kind. Nor do I recollect meeting with any mention of them, in the works of the numerous travellers in the equatorial regions of the same continent. The same remark certainly holds good with Australia in the parallel of Sydney, but perhaps is more doubtful with respect to Van Diemen's Land.† To my mind these negative facts‡ have

* La Condamine's Voyage (English translation), p. 24.

† I will here put together all the (apparent?) exceptions which I have met with to the supposed law that erratic blocks are absent in the intertropical regions of the world. First, in the Bulletin de la Société Géologique, 1837, p. 234, there is an account of some erratic blocks near Macao (lat. 22° N.); but as it is distinctly stated they are all of granite,

very great weight in support of the mass of positive evidence which Mr. Lyell* has brought to bear upon the question.

and the greater number of even the same coloured variety, as the granitic rock, on which they rest, the case need not be considered. Secondly, in a late number of the Madras Journal, Dr. Benza has described some erratic blocks lying on a plain between the Neilgherries (lat. 12° N.) and Madras. He states that the foundation-rock of the country is gneiss, "while the granite clusters are more elevated, and affect either a prismatic form, or are piled up *one on the other*, like *logging stones*." Dr. Benza had the kindness to inform me that these masses are very large, and that several are piled one upon the other. Again, Brongniart says (Tableau de Terrains, p. 83), "On cite aussi dans l'Inde, au pays d'Hyderabad (lat. 17° N.), des blocs *énormes* de granite, *amoncelés* les uns sur les autres" (Deluc neveu). Every one must draw his own conclusions from these accounts, regarding the probability of erratic blocks being heaped up, one upon the other, *like logging stones*. The same doubt likewise partly applies to the Macao case. With respect to the boulders of Hyderabad, Dr. T. Christie has distinctly stated (Edin. New Phil. Jour., Oct. 1828, p. 102), that they are *in situ*, and has explained their origin. For my own part, I cannot forget that whole granitic hills at the Cape of Good Hope, which, from weathering, have assumed a boulder-like form, were once described as transported masses. The two next cases do not properly come under consideration, for they refer to masses lying in the *valleys* of lofty mountains. We must not overlook such accidents as bursting of lakes, earthquakes, and the action of former coast-lines. Helms, in his Travels (English translation, p. 45), states he was astonished to find the highest snow-capped mountains near Potosi (20° N.) covered with a stratum of rounded granitic stones. He supposes they must have come from Tucuman, which is several hundred miles distant: yet at p. 55 he says, at Iocalla (a few leagues only from Potosi), "a mass of granite many miles in length, rises in huge weatherbeaten rocks:" the whole account is to me quite unintelligible. Lastly, M. Gay (Annales des Sciences, 1833) describes granitic boulders within the valley of Cauquenes (lat. 33°-34° S.), in the Cordillera. I visited this place: the boulders and pebbles are not large, and those beyond the mouth of the valley are small. The case did not appear to me nearly so extraordinary as it seems to have struck M. Gay. I cannot agree with his assertion that this rock is not found in that part of the Cordillera: but this is a subject which I shall discuss in a future work.

‡ The absence of great embedded fragments in the formations of the secondary epoch, when we know that the climate was of a more tropical character, is a fact of the same kind.

The circumstance of a luxuriant vegetation with a tropical character so largely encroaching on the temperate zones, under the same kind of climate that allows of a limit of perpetual snow of little altitude, and consequent descent of the glaciers into the sea, is very important; because it has been argued, with great apparent truth, that as there is the strongest presumptive evidence of a gradual cooling down of the climate (or rather of a less favourable state for tropical productions) in Europe, it is most unphilosophical to imagine that formerly glaciers could have acted where they do not now occur. It may be asked; what are the circumstances in the southern hemisphere that produce such results? Must we not attribute them to the large proportional area of water; and do not plain geological inferences compel us to allow, that during the epoch anterior to the present, the northern hemisphere more closely approached to that condition, than it now does?

We are all so much better acquainted with the position of places in our own, than in any other quarter of the globe, that I will recapitulate what is actually taking place in the southern hemisphere,† only transporting in imagination each part to a corresponding latitude in the north. On this supposition, in the southern provinces of France, magnificent forests, intwined by arborescent grasses, and the trees loaded with parasitical plants, would cover the face of the country. In the latitude of Mont Blanc, but on an island as far eastward as central Siberia, tree-ferns and parasitical orchideæ would thrive amidst the thick woods. Even as far north as central Denmark, humming-birds might be seen fluttering about delicate flowers, and parrots feeding amidst the evergreen woods, with which the mountains would be clothed down to the water's edge. Nevertheless, the southern part of Scot-

* Anniversary Address to the Geological Society, Feb. 19, 1836, p. 30; and Principles of Geology, vol. i., p. 269, and vol. iv., p. 47, fifth edition.

† It is in the southern hemisphere that we find elephants, rhinoceroses, hippopotomuses, and lions, as far south as lat. 34° 35′. In South America the jaguar occurs in 42°, and the puma in 53°.

land (only removed twice as far to the westward) would present an island "almost wholly covered with everlasting snow," and having each bay terminated by ice-cliffs, from which great masses yearly detached, would sometimes bear with them fragments of rock. This island would only boast of one land bird, a little grass and moss; yet in the same latitude the sea might swarm with living creatures. A chain of mountains, which we will call the Cordillera, running north and south through the Alps (but having an altitude much inferior to the latter), would connect them with the central part of Denmark. Along this whole line nearly every deep sound would end in "bold and astonishing glaciers." In the Alps themselves (with their altitude reduced by about half) we should find proofs of recent elevations, and occasionally terrible earthquakes would cause such masses of ice to be precipitated into the sea, that waves tearing all before them, would heap together enormous fragments, and pile them up in the corners of the valleys. At other times, icebergs, "charged with no inconsiderable blocks of granite,"* would be floated from the flanks of Mont Blanc, and then stranded on the outlying islands of the Jura. Who then will deny the possibility of these things having actually taken place in Europe during a former period, and under circumstances known to be different from the present, when on merely looking to the other hemisphere, we see they are among the daily order of events?

To the northward of our new Cape Horn, we should only have certain knowledge of a few island groups, situated in the latitude of the south part of Norway, and others in that of Ferroe. These, in the middle of summer, would be buried under snow, and surrounded by walls of ice; so that scarcely a living thing of any kind would be supported on the land. If some bold navigator attempted to penetrate beyond these islands towards the pole, he would run a

* Geographical Journal. Capt. King uses these words when alluding to the case in Sir G. Eyre's Sound, which I have more fully described from the information of Mr. Bynoe.

thousand dangers, and only meet an ocean strewed with mountain-masses of ice.

At the Ferroe islands (or we may say a little to the southward of the Wiljui, where Pallas found (in lat. 64° N.) the frozen rhinoceros), a body buried under the surface of the soil would undergo so little decomposition, that years afterwards (as in the instance mentioned at South Shetland, 62°-63° S.), every feature might be recognised perfect and unchanged. I particularly allude to this circumstance, because the case of the Siberian animals preserved with their flesh in the ice, offers the same apparent difficulty with the glaciers; namely, the union in the same hemisphere of a climate in some senses severe, with one allowing of the life of those forms which *at present*, although abounding *without* the tropics, do not approach the frozen zones.

The perfect preservation of the Siberian animals, perhaps presented, till within a few years, one of the most difficult problems which geology ever attempted to solve. On the one hand it was granted, that the carcasses had not been drifted from any great distance by any tumultuous deluge, and on the other it was assumed as certain, that when the animals lived, the climate must have been so totally different, that the presence of ice in the vicinity was as incredible, as would be the freezing of the Ganges. Mr. Lyell in his "Principles of Geology"* has thrown the greatest light on this subject, by indicating the northerly course of the existing rivers with the probability that they formerly carried carcasses in the same direction; by showing (from Humboldt) how far the inhabitants of the hottest countries sometimes wander; by insisting on the caution necessary in judging of habits between animals of the same genius, when the species are not identical; and especially by bringing forward in the clearest manner the probable change from an insular to an extreme climate, as the

* In the fourth and subsequent editions.

consequence of the elevation of the land, of which proofs have lately been brought to light.*

In a former part of this volume, I have endeavoured to prove, that as far as regards the *quantity* of food, there is no difficulty in supposing that these large quadrupeds inhabited sterile regions, producing but a scanty vegetation. With respect to temperature, the woolly covering both of the elephant and the rhinoceros seems at once to render it at least probable (although it has been argued that some animals living in the hottest regions are thickly clothed) that they were fitted for a cold climate. I suppose no reason can be assigned why, during a former epoch, when the pachydermata abounded over the greater part of the world, some species should not have been fitted for the northern regions, precisely as now happens with deer and several other animals.† If, then, we believe that the climate of Siberia, anteriorly to the physical changes above alluded to, had some resemblance with that of the southern hemisphere at the present day—a circumstance which harmonizes well with other facts,‡ as I think has

* Wrangel's Voyage in the Icy Sea in the years 1821, 1822, and 1823. Edited by Professor Parrot, of Dorpat, Berlin, 1826.

† Dr. Fleming first brought this notion forward in two papers published in the Edinburgh Philosoph. Journ. (April, 1829, and Jan. 1830). He adduces the case of allied species of the bear, fox, hare, and ox, living under widely different climates.

‡ Since writing the above, I have been much interested by reading an account by Professor Esmark, which proves that formerly, glaciers in Norway descended to a lower altitude than at present; and therefore, that they came down to the level of the sea in a lower latitude. This, according to generally-received ideas, would indicate a colder climate, and so it was considered to do by Professor Esmark; for he argues from it in favour of Whiston's hypothesis, that the "earth in its aphelion was covered with ice and snow." Professor Esmark describes a glacier-dike, in lat. 58° 57′, as "lying close to the level of the sea, in a district, where you find only a few heaps of perpetual snow in the hollows of the mountains." He says, "Not only the dike itself, but the whole horizontal surface, exhibits proofs that there has been a glacier here, for the plain exactly resembles

been shown by the imaginary case, when we transported existing phenomena from one to the other hemisphere,—the following conclusions may be deduced as probable: First, that the degree of cold formerly was not excessive; secondly, that snow did not for a long time together cover the ground (such not being the case at the extreme parts 55°-56° of S. America); thirdly, that the vegetation partook of a more tropical character than it now does in the same latitudes; and lastly, that at but a short distance to the northward of the country thus circumstanced (even not so far as where Pallas found the entire rhinoceros), the soil might be perpetually congealed: so that if the carcass of any animal should once be buried a few feet beneath the surface, it would be preserved for centuries.

Both Humboldt* and Lyell have remarked, that at the present day, the bodies of any animals, wandering beyond the line of perpetual congelation which extends as far south as 62°, if once embedded by any accident a few feet beneath the surface, would be preserved for an indefinite length of time: the same would happen with carcasses drifted by the rivers; and by such means the extinct mammalia may have been entombed. There is only one small step wanting, as it appears to me, and the whole problem would be solved with a degree of simplicity very striking, compared with the several theories first invented. From the account given by

those which I found adjoining the glaciers presently existing between Londfiord and Lomb." (See Ed. New Phil. Journal, p. 117, October 1826.) These facts afford a very strong and admirable confirmation of the view, that the climate of Europe has been gradually changing, from a character resembling that of the southern hemisphere, to its present condition. For on this hypothesis, we might have anticipated, that proofs would have been discovered, that glaciers formerly descended to a lower altitude than they now do; and yet, that the organic remains of that epoch, instead of a former period of refrigeration, would have indicated a climate of a more tropical character;—a conclusion, which may be deduced from plain geological evidence.

* See Humboldt, Fragmens Asiatiques, vol. ii., pp. 385—395.

Mr. Lyell of the Siberian plains, with their innumerable fossil bones, the relics of many successive generations, there can be little doubt that the beds were accumulated either in a shallow sea, or in an estuary. From the description given in Beechey's voyage of Eschscholtz Bay, the same remark is applicable to the north-west coast of America: the formation there appears identical with the common littoral deposits* recently elevated, which I have seen on the shores of the southern part of the same continent. It seems also well established, that the Siberian remains are only exposed where the rivers intersect the plain. With this fact, and the proofs of recent elevation, the whole case appears to be precisely similar to that of the Pampas: namely, that the carcasses were formerly floated into the sea, and the remains covered up in the deposits which were then accumulating. These beds have since been elevated; and as the rivers excavate their channels the entombed skeletons are exposed.

Here then, is the difficulty: how were the carcasses preserved at the bottom of the sea? I do not think it has been sufficiently noticed, that the preservation of the animal with its flesh was an occasional event, and not directly consequent on its position far northward. Cuvier† refers to the voyage of Billing as showing that the *bones* of the elephant, buffalo, and rhinoceros, are nowhere so abundant as on the islands between the mouths of the Lena and Indigirska. It is even said that excepting some hills of rock, the whole is composed of sand, ice, and bones. These islands lie to the northward of the place where Adams found the mammoth with its flesh preserved, and even ten degrees north of the Wiljui, where the rhinoceros was discovered in a like condition. In the case of the *bones* we may suppose that the carcasses were

* See some remarks by Dr. Buckland on the similarity of this formation with the deposits so commonly found over a great part of Europe. Appendix to Beechey's Voyage, p. 609.

† Ossemens Fossiles, vol. i., p. 151.

drifted into a deeper sea, and there remaining at the bottom, the flesh decomposed.* But in the second and more extraordinary case, where putrefaction seems to have been arrested, the body probably was soon covered up by deposits which were then accumulating. It may be asked, whether the mud a few feet deep, at the bottom of a shallow sea which is annually frozen, has a temperature higher than 32°? It must be remembered how intense a degree of cold is required to freeze salt water; and that the mud at some depth below the surface, would have a low mean temperature, precisely in the same manner as the subsoil on the land is frozen in countries which enjoy a short but hot summer. If this be possible,† the entombment of these extinct quadru-

* Under these circumstances of slow decomposition, the surrounding deposits would probably be impregnated with much animal matter; and thus the peculiar odour perceived in the neighbourhood of the strata containing fossil bones at Eschscholtz Bay, may be accounted for. See Appendix to Beechey's Voyage.

† With respect to the possibility of even ice accumulating at the bottom of the sea, I shall only refer to the following passage taken from the English translation of the *Expedition to the East Coast of Greenland, by Captain W. Graah, Danish Royal Navy.* "Nor is this the only danger to be apprehended: the ice off this blink, even to a considerable distance from it, being said to shoot up from the bottom of the sea in such a manner, and in such masses, as in many years to make it utterly impassable. How to account for the phenomenon to which I have just adverted I know not, unless by supposing that the bottom of the sea itself is hereabouts like the dry land covered with a thick crust of ice. But whether this crust is formed upon the spot, or is the remains of icebergs and the heavy drift-ice frozen to the bottom during severe winters, or a portion of the land-ice, which loaded with stones and fragments of the crumbling hill has protruded itself into the sea, is a problem impossible, perhaps to solve." Again he says: "We passed it without any accident, and without having observed any thing of that upheaving of the ice off it, to which allusion has been made, though the fact of its occurrence cannot be doubted, the very name of the place, Puisortok, being thence derived." It seems fully established on excellent testimony (see Journ. of Geograph. Soc., vol. v., p. 12, and vol. vi., p. 416; also a collection of notices in Edinburgh Journal of Nat. and Geograph. Soc., vol. ii., p. 55), that fresh-water rivers in Russia and Siberia, and even in England, often freeze at

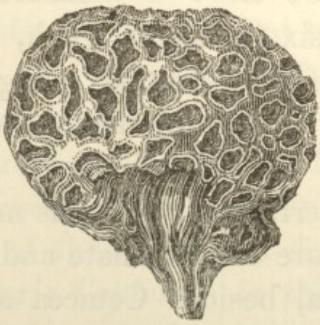
peds is rendered very simple; and with regard to the conditions of their former existence, the principal difficulties have, I think, already been removed.

Having concluded this long discussion on the analogies which may be drawn from the existing climate of the southern parts of America, together with its productions, we will return to the description of Tierra del Fuego.

There is one vegetable production in this country which is worthy of mention, as it affords a staple article of food to the aborigines. It is a globular fungus of a bright yellow colour, and of about the size of a small apple, which adheres in vast numbers to the bark of the beech-trees. It probably forms a new genus, allied to the morell. In the young state it is elastic and turgid, from being charged with moisture. The external skin is smooth, yet slightly marked with small circular pits, like those from the smallpox. When cut in two, the inside is seen to consist of a white fleshy substance, which viewed under a high power resembles, from the numerous thread-like cylinders, vermicelli. Close beneath the surface, cup-shaped balls, about one-twelfth of an inch in diameter, are arranged at regular intervals. These cups are filled with a slightly adhesive, yet elastic, colourless, quite transparent matter; and from the latter character they at first appeared empty. These little gelatinous balls could be easily detached from the surrounding mass, except at the upper extremity, where the edge divided itself into threads, which mingled with the rest of the vermicelli-like mass. The external skin directly above each of the balls is pitted, and as the fungus grows old, it is ruptured, and the gelatinous mass, which no doubt contains the sporules, is disseminated.

the bottom, and that the flakes of ice when they rise to the surface, often "bring with them large stones." All that seems to be required in producing ground-ice, is, that there should be sufficient movement in the fluid, so that the whole is cooled down to the freezing point, and then the water *crystallizes*, wherever there is a point of attachment.

After this process of fructification has taken place, the whole surface becomes honeycombed, with empty cells (as represented in the accompanying woodcut), and the fungus



shrinks, and grows tougher. In this state it is eaten by the Fuegians, in large quantities, uncooked, and when well chewed has a mucilaginous and slightly sweet taste, together with a faint odour like that of a mushroom. Excepting a few berries of a dwarf arbutus, which need hardly be taken into the account, these poor savages never eat any other vegetable food besides this fungus.*

I have already mentioned the sombre and dull character of the forests,† in which two or three species of trees grow, to the exclusion of all others. Above the forest land, there are many dwarf alpine plants, which all spring from the mass of peat, and help to compose it. The central part of Tierra del Fuego, where the clay-slate formation

* In New Zealand, before the introduction of the potato, the root of the fern was consumed in large quantities. At the present day I should think Tierra del Fuego was the only country in the world, where a cryptogamic plant afforded a staple article of food.

† Captain FitzRoy informs me that in April (our October) the leaves of those trees which grow near the base of the mountains change colour, but not those in the more elevated parts. I remember having read some observations showing, that in England the leaves fall earlier in a warm and fine autumn, than in a late and cold one. This change in the colour being retarded in the more elevated and therefore colder situations, must be owing to the same general law of vegetation. The trees of Tierra del Fuego during no part of the year entirely shed their leaves.

occurs, is most favourable to the growth of trees; on the outer coast the poorer granitic soil, and a situation more exposed to the violent winds, do not allow of their attaining any great size. Near Port Famine I have seen more large trees than any where else: I measured a winter's bark which was four feet six inches in girth, and several of the beech were thirteen feet. Captain King also mentions one of the latter which was seven feet in diameter, seventeen feet above the roots.

The zoology of Tierra del Fuego, as might have been expected from the nature of its climate and vegetation, is very poor. Of mammalia, besides Cetacea and Phocæ, there is one bat, a mouse with grooved front teeth (*Reithrodon* of Waterhouse), and two other species, the tucutuco (the greater number of these rodents are confined to the eastern and dry part), a fox, sea-otter, guanaco, and one deer. The latter animal is rare, and is not, I believe, to be found south of the Strait of Magellan, as happens with the others.

Observing the general correspondence of the cliffs of soft sandstone, mud, and shingle, on the opposite sides of the Strait, together with those on some intervening islands, one is strongly tempted to believe that the land was once joined, and thus allowed animals so delicate and helpless as the tucutuco, and Reithrodon, to pass over. The correspondence of the cliffs is far from proving any junction; because such cliffs generally are formed by the intersection of sloping deposits, which, before the elevation of the land, had been accumulated near the then existing shores. It is, however, a remarkable coincidence, that in the two large islands cut off by the Beagle channel from the rest of Tierra del Fuego, one has cliffs composed of matter that may be called stratified alluvium, which front similar ones on the opposite side of the channel,—while the other is exclusively bordered by the older rocks: in the former, called Navarin Island, both foxes and guanacoes occur; but in the latter, Hoste Island, although similar in every respect, and only separated by a channel a little more than half a mile wide, I have the word of Jemmy

Button for saying that neither of these animals are found. I must confess to an exception to the rule, in the presence of a small mouse, of a species occurring likewise in Patagonia.

The gloomy woods are inhabited by few birds: occasionally the plaintive note of a white tufted tyrant-flycatcher may be heard, concealed near the summit of the most lofty trees; and more rarely the loud strange cry of a black woodpecker, with a fine scarlet crest on its head. A little, dusky-coloured wren (*Scytalopus fuscus*) hops in a skulking manner among the entangled mass of the fallen and decaying trunks. But the creeper (*Synallaxis Tupinieri*) is the commonest bird in the country. Throughout the beech forests, high up and low down, in the most gloomy, wet, and impenetrable ravines, it may be met with. This little bird no doubt appears more numerous than it really is, from its habit of following, with seeming curiosity, any person who enters these silent woods: continually uttering a harsh twitter, it flutters from tree to tree, within a few feet of the intruder's face. It is far from wishing for the modest concealment of the true creeper (*Certhia familiaris*), nor does it, like that bird, run up and down the trunks of trees; but industriously, after the manner of a willow wren, hops about, and searches for insects on every twig and branch. In the more open parts three or four species of finches, a thrush, a starling (or *Icterus*), two furnarii, and several hawks and owls occur.

The absence of any species whatever in the whole class of Reptiles is a marked feature in the zoology of this country, as well as in that of the Falkland Islands. I do not ground this statement merely on my own observation, but I heard it from the Spanish inhabitants of the latter place, and from Jemmy Button with regard to Tierra del Fuego. On the banks of the St. Cruz in 50° south, I saw a frog; and it is not improbable that these animals, as well as lizards, may be found as far south as the Strait of Magellan, where the country retains the character of Patagonia; but within the

damp and cold limit not one occurs. That the climate would not have suited some of the orders, such as lizards, might have been foreseen; but with respect to frogs, this was not so obvious.

Coleopterous insects occur in very small numbers. Until I had endeavoured by every means to find them, I could not believe, that a country as large as Scotland, covered with vegetable productions, and with a variety of stations, would ever have been so unproductive. The greater part of my small collection consists of alpine insects (*Harpalidæ* and *Heteromera*) found beneath stones, above the limit of the forest. Lower down, with the exception of some few Curculiones scarcely any could be found. The Chrysomelidæ, which are so pre-eminently characteristic of the Tropics, are here almost entirely absent.* This must depend on the climate; for the quantity of vegetable matter is superfluously great. In the hottest part of the summer the mean of the maxima for thirty-seven successive days was 55°, and the thermometer on some of the days rose to 60°; yet there were no orthoptera, very few diptera, lepidoptera, or hymenoptera. In the pools of water I found but few aquatic beetles, and not any fresh-water shells. Succinea at first appears an exception; but here it must be called a terrestrial species, for it lives on the damp herbage far from water. Land shells could only be procured in the same situations with the alpine beetles. I have already contrasted the climate, as well as the general appearance of Tierra del Fuego with that of Patagonia; and the difference is strongly exemplified in the entomology.

* I believe I must except one alpine Haltica, and a single specimen of a Melasoma. Mr. Waterhouse, who was good enough to look at my collection from this place, tells me, that of the Harpalidæ there are eight or nine species,—the forms of the greater number being very peculiar; of Heteromera, four or five species; of Rhyncophora six or seven; and of the following families one species in each: Staphylinidæ, Elateridæ, Cebrionidæ, Melolonthidæ The species in the other orders, were even fewer. In all the orders, the scarcity of the individuals was even more remarkable than that of the species.

I do not believe they have a species in common; certainly the general character of the insects is widely different.

If we turn from the land to the sea, we shall find the latter as abundantly stocked with living creatures as the former is poorly so. In all parts of the world a rocky and partially protected shore perhaps supports, in a given space, a greater number of individual animals than any other kind of station. Here, under every stone, numerous crawling creatures swarmed, and especially crustacea of the family of *Cymothoades*. The number of Sphæroma was truly wonderful: as these animals, when coiled up, have some resemblance to Trilobites, they were an interesting sight to a geologist. On the tidal rocks patelliform shells of large size were very abundant. Even at the depth of forty or fifty fathoms, the bottom of the sea was far from sterile, as was shown by the abundance of small strong corallines.

There is one marine production, which from its importance is worthy of a particular history. It is the kelp or *Fucus giganteus* of Solander. This plant grows on every rock from low-water mark to a great depth, both on the outer coast and within the channels. I believe, during the voyages of the Adventure and Beagle, not one rock near the surface was discovered, which was not buoyed by this floating weed. The good service it thus affords to vessels navigating near this stormy land is evident; and it certainly has saved many a one from being wrecked. I know few things more surprising than to see this plant growing and flourishing amidst those great breakers of the western ocean, which no mass of rock, let it be ever so hard, can long resist. The stem is round, slimy, and smooth, and seldom has a diameter of so much as an inch. A few taken together are sufficiently strong to support the weight of the large loose stones to which in the inland channels they grow attached; and some of these stones are so heavy, that when drawn to the surface they can scarcely be lifted into a boat by one person.

Captain Cook, in his second voyage, says, that at Kerguelen Land "some of this weed is of a most enormous

length, though the stem is not much thicker than a man's thumb. I have mentioned, that on some of the shoals upon which it grows, we did not strike ground with a line of twenty-four fathoms. The depth of water, therefore, must have been greater. And as this weed does not grow in a perpendicular direction, but makes a very acute angle with the bottom, and much of it afterwards spreads many fathoms on the surface of the sea, I am well warranted to say that some of it grows to the length of sixty fathoms and upwards." Certainly at the Falkland Islands, and about Tierra del Fuego, extensive beds frequently spring up from ten and fifteen fathom water. I do not suppose the stem of any other plant attains so great a length as 360 feet, as stated by Captain Cook. Its geographical range is very considerable; it is found from the extreme southern islets near Cape Horn, as far north, on the eastern coast (according to information given me by Mr. Stokes), as lat. 43°,—and on the western it was tolerably abundant, but far from luxuriant, at Chiloe, in lat. 42°. It may possibly extend a little further northward, but is soon succeeded by a different species. We thus have a range of fifteen degrees in latitude; and as Cook, who must have been well acquainted with the species, found it at Kerguelen Land, no less than 140° in longitude.

The number of living creatures of all orders, whose existence intimately depends on the kelp, is wonderful. A great volume might be written, describing the inhabitants of one of these beds of sea-weed. Almost every leaf, excepting those that float on the surface, is so thickly incrusted with corallines, as to be of a white colour. We find exquisitely-delicate structures, some inhabited by simple hydra-like polypi, others by more organized kinds, and beautiful compound Ascidiæ.* On the flat surfaces of the leaves various patelliform shells, Trochi, uncovered molluscs, and some bivalves are attached. Innumerable crustacea frequent every part of

* I have reason to believe that many of these animals are exclusively confined to this station.

the plant. On shaking the great entangled roots, a pile of small fish, shells, cuttle-fish, crabs of all orders, sea-eggs, star-fish, beautiful Holuthuriæ (some taking the external form of the nudibranch molluscs), Planariæ, and crawling nereidous animals of a multitude of forms, all fall out together. Often as I recurred to a branch of the kelp, I never failed to discover animals of new and curious structures. In Chiloe, where, as I have said, the kelp did not thrive very well, the numerous shells, corallines, and crustacea were absent; but there yet remained a few of the flustraceæ, and some compound Ascidiæ; the latter, however, were of different species from those in Tierra del Fuego. We here see the fucus possessing a wider range than the animals which use it as an abode.

I can only compare these great aquatic forests of the southern hemisphere with the terrestrial ones in the intertropical regions. Yet if the latter should be destroyed in any country, I do not believe nearly so many species of animals would perish, as, under similar circumstances, would happen with the kelp. Amidst the leaves of this plant numerous species of fish live, which nowhere else would find food or shelter; with their destruction the many cormorants, divers, and other fishing birds, the otters, seals, and porpoises, would soon perish also; and lastly, the Fuegian savage, the miserable lord of this miserable land, would redouble his cannibal feast, decrease in numbers, and perhaps cease to exist.

June 8th.—We weighed anchor early in the morning, and left Port Famine. Captain FitzRoy determined to leave the Strait of Magellan by the Magdalen channel, which had not long been discovered. Our course lay due south, down that gloomy passage which I have before alluded to, as appearing to lead to another and worse world. The wind was fair, but the atmosphere was very thick; so that we missed much curious scenery. The dark ragged clouds were rapidly driven over the mountains, from their summits nearly to their bases. The glimpses which we caught through the

dusky mass were highly interesting: jagged points, cones of snow, blue glaciers, strong outlines marked on a lurid sky, were seen at different distances and heights. In the midst of such scenery we anchored at Cape Turn, close to Mount Sarmiento, which was then hidden in the clouds. At the base of the lofty and almost perpendicular sides of our little cove, there was one deserted wigwam, and it alone reminded us that man sometimes wandered in these desolate regions. But it would be difficult to imagine a scene where he seemed to have less claims, or less authority. The inanimate works of nature—rock, ice, snow, wind, and water—all warring with each other, yet combined against man—here reigned in absolute sovereignty.

June 9th.—In the morning we were delighted by seeing the veil of mist gradually rise from Sarmiento, and display it to our view. This mountain, which is one of the highest in Tierra del Fuego, has an elevation of 6800 feet. Its base, for about an eighth of its total height, is clothed by dusky woods, and above this a field of snow extends to the summit. These vast piles of snow, which never melt, and seem destined to last as long as the world holds together, present a noble and even sublime spectacle. The outline of the mountain was admirably clear and defined. Owing to the abundance of light reflected from the white and glittering surface, no shadows are cast on any part; and those lines which intersect the sky can alone be distinguished: hence the mass stood out in the boldest relief. Several glaciers descended in a winding course, from the snow to the sea-coast: they may be likened to great frozen Niagaras; and perhaps these cataracts of blue ice are to the full as beautiful as the moving ones of water. By night we reached the western part of the channel; but the water was so deep that no anchorage could be found. We were in consequence obliged to stand off and on, in this narrow arm of the sea, during a pitch-dark night of fourteen hours long.

June 10th.—In the morning we made the best of our way into the open Pacific. The Western coast generally

consists of low, rounded, quite barren, hills of granite and greenstone. Sir John Narborough called one part South Desolation, because it is "so desolate a land to behold;" and well indeed might he say so. Outside the main islands there are numberless scattered rocks, on which the long swell of the open ocean incessantly rages. We passed out between the East and West Furies, and a little further northward there are so many breakers that the sea is called the Milky Way. One sight of such a coast is enough to make a landsman dream for a week about shipwreck, peril, and death; and with this sight, we bade farewell for ever to Tierra del Fuego.

CHAPTER XIV.

Valparaiso—Excursion to base of Andes—Structure of land—Ascend Bell of Quillota—Shattered masses of greenstone—Immense valleys—Mines—State of miners—Santiago—Hot baths of Cauquenes—Gold mines—Grinding mills—Perforated stones—Habits of puma—El turco and tapacolo—Humming-birds.

CENTRAL CHILE.

JULY 23D.—The Beagle anchored late at night in the bay of Valparaiso, the chief seaport of Chile. When morning came, every thing appeared delightful. After Tierra del Fuego, the climate felt quite delicious—the atmosphere so dry, and the heavens so clear and blue, with the sun shining brightly, that all nature seemed sparkling with life. The view from the anchorage is very pretty. The town is built at the very foot of a range of hills, about 1600 feet high, and rather steep. From its position, it consists of one long, straggling street, which runs parallel to the beach, and wherever a ravine comes down, the houses are piled up on each side of it. The rounded hills, being only partially protected by a very scanty vegetation, are worn into numberless little gullies, which expose a singularly bright red soil. From this cause, and from the low whitewashed houses with tile roofs, the view reminded me of St. Cruz in Teneriffe. In a north-easterly direction there are some fine glimpses of the Andes: but these mountains appear much grander when viewed from the neighbouring hills; the great distance at which they are situated can then more readily be perceived. The volcano of Aconcagua is particularly magnificent. This huge and irregularly conical mass has an elevation greater than that of Chimborazo; for, from measurements made by the officers in the Beagle, its height is no less than 23,000 feet. The Cordillera, however, viewed from

this point, owe the greater part of their beauty to the atmosphere through which they are seen. When the sun was setting in the Pacific, it was admirable to watch how clearly their rugged outlines could be distinguished, yet how varied and how delicate were the shades of their colour.

I had the good fortune to find living here Mr. Richard Corfield, an old schoolfellow and friend, to whose hospitality and kindness I was greatly indebted, in having afforded me a most pleasant residence during the Beagle's stay in Chile. The immediate neighbourhood of Valparaiso is not very productive to the naturalist. The surrounding hills consist of a granitic formation, which sometimes assumes the character of gneiss, and sometimes of granite. Their summits are flat-topped, and their flanks rounded. I have before stated, that forests cover that side of the Cordillera which fronts the prevailing winds. Here, during the summer, which forms the longer portion of the year, the winds blow steadily from the southward, and a little off shore, so that rain never falls: during the three winter months it is however sufficiently abundant. The vegetation in consequence is very scanty. Except in some deep valleys, trees nowhere occur, and only a little grass and a few low bushes are scattered over the less steep parts of the hills. When we reflect that, at the distance of 350 miles to the southward, this side of the Andes is completely hidden by one impenetrable forest, the contrast is very remarkable.

I took several long walks while collecting objects of natural history. The country is pleasant for exercise. There are many very beautiful flowers, and as in most other dry climates, the plants and shrubs possess strong and peculiar odours; even one's clothes by brushing through them became scented. I did not yet cease from wonder, at finding each succeeding day as fine as the foregoing. What a difference does climate make in the enjoyment of life! How opposite are the sensations when viewing black mountains half-enveloped in clouds, and seeing another range through the light

blue haze of a fine day! The one for a time may be very sublime; the other is all gaiety and happy life.

August 14th.—I set out on a riding excursion, for the purpose of geologizing the basal parts of the Andes, which alone at this time of the year were not shut up by the winter snow. Our first day's ride was northward along the sea-coast. After dark we reached the Hacienda of Quintero, the estate which formerly belonged to Lord Cochrane. My object in coming here was to see the great beds of shells, which are elevated some yards above the level of the sea. They nearly all consist of one species of Erycina; and these shells at the present day live together in great numbers, on the sandy flats. So wonderfully numerous are those forming the beds, that for years they have been quarried, and burnt for the lime, with which the large town of Valparaiso is supplied. As any change of level, even in this neighbourhood, has often been disputed, I may add, that I saw dead barnacles adhering to points of solid rock which were now so much elevated, that even during gales of wind they would scarcely be wetted by the spray.

15th.—We returned towards the valley of Quillota. The country was exceedingly pleasant; just such as poets would call pastoral: green open lawns, separated by small valleys with rivulets, and the cottages, we will suppose of the shepherds, scattered on the hill-sides. We were obliged to cross the ridge of the Chilecauquen. At its base there were many fine evergreen forest-trees, but these only flourished in the ravines, where there was running water. Any person who had seen only the country near Valparaiso, would never have imagined that there had been such picturesque spots in Chile. As soon as we reached the brow of the Sierra, the valley of Quillota was immediately under our feet. The prospect was one of remarkable artificial luxuriance. The valley is very broad and quite flat, and is thus easily irrigated in all parts. The little square gardens are crowded with orange and olive trees, and every sort of vegetable. On each side huge bare mountains rise, and this from the contrast renders the patch-

work valley the more pleasing. Whoever called "Valparaiso" the "Valley of Paradise," must have been thinking of Quillota. We crossed over to the Hacienda de San Isidoro, situated at the very foot of the Bell mountain.

Chile, as may be seen in the maps, is a narrow strip of land between the Cordillera and the Pacific; and this strip is itself traversed by several mountain-lines, which in this part run parallel to the great range. Between these outer lines, and the main Cordillera, a succession of level basins, generally opening into each other by narrow passages, extend far to the southward. In these the principal towns are situated, as San Felipe, Santiago, S. Fernando. These basins or plains, together with the transverse flat valleys (like that of Quillota) which connect them with the coast, I have little doubt, are the bottoms of ancient inlets and deep bays, such as at the present day intersect every part of Tierra del Fuego, and the west coast of Patagonia. Chile must formerly have resembled the latter country, in the configuration of its land and water. This resemblance was occasionally seen with great force, when a level fog-bank covered, as with a mantle, all the lower parts of the country: the white vapour curling into the ravines, beautifully represented little coves and bays; and here and there a solitary hillock peeping up, showed that it had formerly stood there as an islet. The contrast of these flat valleys and basins with the irregular mountains, gave the scenery a character which to me was novel and very interesting.

From the natural slope to seaward of these plains, they are very easily irrigated, and in consequence singularly fertile. Without this process the land would produce scarcely any thing; for during the whole summer the sky is cloudless. The mountains and hills are dotted over with bushes and low trees, and excepting these, the vegetation is very scanty. Each landowner in the valley possesses a certain portion of hill-country, where his half-wild cattle, in considerable numbers, manage to find sufficient pasture. Once every year there is a grand "rodeo,"

when all the cattle are driven down, counted, and marked, and a certain number separated to be fattened in the irrigated fields. Wheat is extensively cultivated, and also a good deal of Indian corn: a kind of bean is, however, the staple article of food for the common labourers. The orchards produce an overflowing abundance of peaches, figs, and grapes. With all these advantages, the inhabitants of the country ought to be much more prosperous than they are.

August 16th.—The mayor-domo of the Hacienda was good enough to give me a guide and fresh horses; and in the morning we set out to ascend the Campana, or Bell mountain, which is 6400 feet high. The paths were very bad, but both the geology and scenery amply repaid the trouble. We reached, by the evening, a spring called the Agua del Guanaco, which is situated at a great height. This must be an old name, for it is very many years since a guanaco has drunk its waters. During the ascent I noticed that nothing grew on the northern slope but bushes, whilst on the southern there was a sort of bamboo, about fifteen feet high. In a few places there were palms, and I was surprised to see one at an elevation of at least 4500 feet. These palms are, for their family, ugly trees. Their stem is very large, and of a curious form, being thicker in the middle than at the base or top. They are excessively numerous in some parts of Chile, and valuable on account of a sort of treacle made from the sap. On one estate near Petorca, they tried to count them, but failed, after having numbered several hundred thousand. Every year in August (early spring time) very many are cut down, and when the trunk is lying on the ground, the crown of leaves is lopped off. The sap then immediately begins to flow from the upper end, and continues so doing for some months: it is, however, necessary that a thin slice should be shaved off from that end every morning, so as to expose a fresh surface. A good tree will give ninety gallons, and all this must have been contained in the vessels of the apparently dry trunk. It is said that the sap flows much more quickly on those days when the sun is powerful; and likewise,

that it is absolutely necessary to take care, in cutting down the tree, that it should fall with its head upwards on the side of the hill; for if it falls down the slope, scarcely any sap will flow; although in that case, one would have thought that the action would have been aided, instead of checked, by the force of gravity. The sap is concentrated by boiling, and is then called treacle, which it very much resembles in taste.

We unsaddled our horses near the spring, and prepared to pass the night. The evening was fine, and the atmosphere so clear, that the masts of the vessels at anchor in the bay of Valparaiso, although no less than twenty-six geographical miles distant, could be distinguished clearly, as little black streaks. A ship doubling the point under sail appeared as a bright white speck. Anson expresses much surprise, in his voyage, at the distance his vessels were discovered from the coast; but he did not sufficiently allow for the height of the land, and the great transparency of the air.

The setting of the sun was glorious; the valleys being black, whilst the snowy peaks of the Andes yet retained a ruby tint. When it was dark, we made a fire beneath a little arbour of bamboos, fried our charqui (or dried strips of beef), took our maté, and were quite comfortable. There is an inexpressible charm in thus living in the open air. The evening was calm and still;—the shrill noise of the mountain bizcacha, and the faint cry of the goatsucker, were only occasionally to be heard. Besides these, few birds, or even insects, frequent these dry, parched mountains.

August 17th.—In the morning we climbed up the rough mass of greenstone which crowns the summit. This rock, as frequently happens, was much shattered and broken into huge angular fragments. I observed, however, one remarkable circumstance, namely, that many of the surfaces presented every degree of freshness—some appearing as if broken the day before, whilst on others lichens had either just become, or had long grown, attached. I so fully believed that this was owing to the frequent earthquakes, that I felt inclined to hurry from beneath every pile of the loose

masses. As this is an observation in which one would be very apt to be deceived, I doubted its accuracy, until ascending Mount Wellington, near Hobart Town. The summit of that mountain is similarly composed, and similarly shattered; but all the blocks appeared as if they had been hurled into their present position thousands of years ago.

We spent the day on the summit, and I never enjoyed one more thoroughly. Chile, bounded by the Andes and the Pacific, was seen as in a map. The pleasure from the scenery, in itself beautiful, was heightened by the many reflections which arose from the mere view of the grand range, with its lesser parallel ones, and of the broad valley of Quillota directly intersecting the latter. Who can avoid admiring the wonderful force which has upheaved these mountains, and even more so the countless ages which it must have required, to have broken through, removed, and levelled whole masses of them? It is well in this case to call to mind the vast shingle and sedimentary beds of Patagonia, which, if heaped on the Cordillera, would increase by so many thousand feet its height. When in that country, I wondered how any mountain-chain could have supplied such masses, and not have been utterly obliterated. We must not now reverse the wonder, and doubt whether all-powerful time can grind down mountains—even the gigantic Cordillera—into gravel and mud.

The appearance of the Andes was different from that which I had expected. The lower line of the snow was of course horizontal, and to this line the even summits of the range seemed quite parallel. Only at long intervals a mass of points, or a single cone, showed where a volcano had existed, or does now exist. Hence the range resembled a great solid wall, surmounted here and there by a tower, and thus made a most complete barrier to the country.

Almost every part of the hill has been drilled by attempts to open gold-mines. I was surprised to see, on the actual summit, which could only be reached by climbing, a small pit, where some yellowish crystals of hypersthene had

induced somebody to throw away his labour. The rage for mining has left scarcely a spot in Chile unexamined. I spent the evening as before, talking round the fire with my two companions. The Guasos of Chile, which correspond to the Gauchos of the Pampas, are, however, a very different set of beings. Chile is the more civilized of the two countries, and the inhabitants, in consequence, have lost much individual character. Gradations in rank are much more strongly marked: the Guaso does not by any means consider every man his equal; and I was quite surprised to find that my companions did not like to eat at the same time with myself. This feeling of inequality is a necessary consequence of the existence of an aristocracy of wealth. It is said that some few of the greater landowners possess from five to ten thousand pounds sterling per annum: an inequality of riches which I believe is not met with in any of the cattle-breeding countries to the eastward of the Andes. A traveller does not here meet that unbounded hospitality which refuses all payment, but yet is so kindly offered that no scruples can be raised in accepting it. Almost every house in Chile will receive you for the night, but a trifle is expected to be given in the morning; even a rich man will accept two or three shillings. The Gaucho, although he may be a cut-throat, is a gentleman; the Guaso is in few respects better, but at the same time a vulgar, ordinary fellow. The two men, although employed much in the same manner, are different in their habits and attire; and the peculiarities of each are universal in their respective countries. The Gaucho seems part of his horse, and scorns to exert himself excepting when on its back; the Guaso may be hired to work as a labourer in the fields. The former lives entirely on animal food; the latter almost wholly on vegetable. We do not here see the white boots, the broad drawers, and scarlet chilipa; the picturesque costume of the Pampas. Here, common trousers are protected by black and green worsted leggings. The poncho, however, is common to both. The chief pride in the Guaso lies in his spurs;

which are absurdly large. I measured one which was six inches in the *diameter* of the rowel, and the rowel itself contained upwards of thirty points. The stirrups are on the same scale, each consisting of a square, carved block of wood, hollowed out, yet weighing three or four pounds. The Guaso is perhaps more expert with the lazo than the Gaucho; but, from the nature of the country, he does not know the use of the bolas.

August 18th.—We descended the mountain, and passed some beautiful little spots, with rivulets and fine trees. Having slept at the same hacienda as before, we rode during the two succeeding days up the valley, and passed through Quillota, which is more like a collection of nursery-gardens than a town. The orchards were beautiful, presenting one mass of peach-blossoms. I saw also in one or two places the date-palm. It is a most stately tree; and I should think a group of them in their native Asiatic and African deserts must be superb. We passed likewise San Felipe, a pretty straggling town like Quillota. The valley in this part expands into one of those great bays or plains, reaching to the foot of the Cordillera, which have been mentioned as forming so curious a part of the scenery of Chile.

In the evening we reached the mines of Jajuel, situated in a ravine at the flank of the great chain. I staid here five days. My host, the superintendent of the mine, was a shrewd but rather ignorant Cornish miner. He had married a Spanish woman, and did not mean to return home; but his admiration for the mines of Cornwall remained unbounded. Amongst many other questions, he asked me, "Now that George Rex is dead, how many more of the family of Rexes are yet alive?" This Rex certainly must be a relation of the great author Finis, who wrote all books!

These mines are of copper, and the ore is all shipped to Swansea, to be smelted. Hence the mines have an aspect singularly quiet, as compared to those in England: here no smoke, furnaces, or great steam-engines, disturb the solitude of the surrounding mountains.

The Chilian government, or rather the old Spanish law, encourages by every method the searching for mines. The discoverer may work a mine on any ground, by paying five shillings; and before paying this he may try, even in the garden of another man, for twenty days.

It is now well known that the Chilian method of mining is the cheapest. My host says the two principal improvements introduced by foreigners have been, first, reducing by previous roasting the copper pyrites—which, being the common ore in Cornwall, the English miners were astounded on their arrival to find thrown away as useless: secondly, stamping and washing the scoriæ from the furnaces—by which process particles of metal are recovered in abundance. I have actually seen mules carrying to the coast, for transportation to England, a cargo of such cinders. But the first case is much the most curious. The Chilian miners were so convinced that copper pyrites contained not a particle of copper, that they laughed at the Englishmen for their ignorance, who laughed in turn, and bought their richest veins for a few dollars. It is very odd that, in a country where mining had been extensively carried on for many years, so simple a process as gently roasting the ore, to expel the sulphur previous to smelting it, had never been discovered. A few improvements have likewise been introduced in some of the simple machinery; but even to the present day, water is removed from some mines by men carrying it up the shaft in leathern bags!

The labouring men work very hard. They have little time allowed for their meals, and during summer and winter they begin when it is light, and leave off at dark. They are paid one pound sterling a month, and their food is given them: this for breakfast consists of sixteen figs and two small loaves of bread; for dinner boiled beans; for supper broken roasted wheat grain. They scarcely ever taste meat; as, with the twelve pounds per annum, they have to clothe themselves, and support their families. The miners who work in the mine itself, have twenty-five shillings per month, and are allowed a little

charqui. But these men come down from their bleak habitations only once in every fortnight or three weeks.

During my stay here I thoroughly enjoyed scrambling about these huge mountains. The geology, as might have been expected, was very interesting. The shattered and baked rocks, traversed by innumerable dykes of greenstone, showed what commotions had formerly taken place there. The scenery was much the same as that near the Bell of Quillota,—dry barren mountains, dotted at intervals by bushes with a scanty foliage. The cactuses, or rather opuntias, were here very numerous. I measured one of as pherical figure, which, including the spines, was six feet and four inches in circumference. The height of the common cylindrical, branching kind is from twelve to fifteen feet, and the girth (with spines) of the branches between three and four.

A heavy fall of snow on the mountains prevented me, during the last two days, from making some interesting excursions. I attempted to reach a lake, which the inhabitants, from some unaccountable reason, believe to be an arm of the sea. During a very dry season, it was proposed to attempt cutting a channel from it, for the sake of the water; but the padre, after a consultation, declared it was too dangerous, as all Chile would be inundated, if, as generally supposed, the lake was connected with the Pacific. We ascended to a great height, but becoming involved in the snow-drifts, failed in reaching this wonderful lake, and had some difficulty in returning. I thought we should have lost our horses; for there was no means of guessing how deep the drifts were, and the animals, when led, could only move by jumping. The black sky showed that a fresh snow-storm was gathering, and we therefore were not a little glad when we escaped. By the time we reached the base, the storm commenced, and it was lucky for us that this did not happen three hours earlier in the day.

August 26th.—We left Jajuel and again crossed the basin of S. Felipe. The day was truly Chilian: glaringly bright, and the atmosphere quite clear. The thick and uni-

form covering of newly-fallen snow rendered the view of the volcano of Aconcagua and the main chain quite glorious. We were now on the road to Santiago, the capital of Chile. We crossed the Cerro del Talguen, and slept at a little rancho. The host, talking about the state of Chile as compared to other countries, was very humble: "Some see with two eyes, and some with one, but for my part I do not think that Chile sees with any."

August 27th.—After crossing many low hills, we descended into the small land-locked plain of Guitron. In the basins, such as this one, which are elevated from 1000 to 2000 feet above the sea, two species of acacia, which are stunted in their forms, and stand wide apart from each other, grow in large numbers. These trees are never found near the sea-coast; and this gives another characteristic feature to the scenery of these basins.

We crossed a low ridge which separates Guitron from the great plain on which Santiago stands. The view was here pre-eminently striking: the dead level surface, covered in parts by woods of acacia, and with the city in the distance, abutting horizontally against the base of the Andes, whose snowy peaks were bright with the evening sun. At the first glance of this view it was quite evident that the plain represented the extent of a former inland sea. As soon as we gained the level road we pushed our horses into a gallop, and reached the city before it was dark.

I staid a week in Santiago, and enjoyed myself very much. In the morning I rode to various places on the plain, and in the evening dined with several of the English merchants, whose hospitality at this place is well known. A never-failing source of pleasure, was to ascend the little pap of rock (fort St. Lucia) which projects in the middle of the city. The scenery certainly is most striking, and as I have said, very peculiar. I am informed that this same character is common to the cities on the great Mexican platform. Of the town I have nothing to say in detail: it is not so fine or so large as Buenos Ayres, but is built after the same

model. I arrived here by a circuit to the north; so I resolved to return to Valparaiso, by a rather longer excursion, to the southward of the direct road.

SEPTEMBER 5TH.—By the middle of the day we arrived at one of the suspension bridges, made of hide, which crosses the Maypo, a large turbulent river, a few leagues south of Santiago. These bridges are very poor affairs. The road, following the curvature of the suspending ropes, is made of bundles of sticks placed close together. It was full of holes, and oscillated rather fearfully, even from the weight of a man leading his horse. In the evening we reached a comfortable farm-house, where there were several very pretty signoritas. They were much horrified at my having entered one of their churches out of mere curiosity. They asked me, "Why do you not become a Christian—for our religion is certain?" I assured them I was a sort of Christian; but they would not hear of it—appealing to my own words, "Do not your padres, your very bishops, marry?" The absurdity of a bishop having a wife, particularly struck them: they scarcely knew whether to be most amused or horror-struck at such an enormity.

6TH.—We proceeded due south, and slept at Rancagua. The road passed over the level but narrow plain, bounded on one side by lofty hills, and on the other by the Cordillera. The next day we turned up the valley of the Rio Cachapual, in which the hot-baths of Cauquenes, long celebrated for their medicinal properties, are situated. The suspension bridges, in the less frequented parts, are generally taken down during the winter, when the rivers are low. Such was the case in this valley, and we were therefore obliged to cross the stream on horseback. This is rather disagreeable, for the foaming water, though not deep, rushes so quickly over the bed of large rounded stones, that one's head becomes quite confused, and it is difficult even to perceive whether the horse is moving onward, or standing still. In summer, when the snow melts, the torrents are quite impassable: their strength and fury is then extremely great;

as might be plainly seen, by the marks which they had left. We reached the baths in the evening, and staid there five days, being confined the two last by heavy rain. The buildings consist of a square of miserable little hovels, each with a single table and bench. They are situated in a narrow deep valley, just without the central Cordillera. It is a quiet, solitary spot, with a good deal of wild beauty.

The mineral springs of Cauquenes burst forth on a line of dislocation, crossing a mass of stratified rock, the whole of which betrays the action of heat. A considerable quantity of gas is continually escaping from the same orifices with the water. Though the springs are only a few yards apart, they have very different temperatures; and this appears to be the result of an unequal mixture of cold water: for those with the lowest temperature have scarcely any mineral taste. After the great earthquake of 1822, the springs ceased, and the water did not return for nearly a year. It is said that they have not since regained their former volume or temperature.* These springs were also much affected by the earthquake of 1835; the temperature being suddenly changed from 118° to 92°.† It seems probable that mineral waters rising deep from the bowels of the earth, would always be more deranged by subterranean disturbances, than those nearer the surface. The man who had charge of the baths assured me, that in summer the water is hotter and more plentiful than in winter. The former circumstance I should have expected, from the less mixture, during the dry season, of cold water; but the latter statement appears very strange and contradictory. The periodical increase during the summer when

* When I doubted the change of temperature, in this case as well as in the one mentioned a few lines lower down, the inhabitants maintained that they knew it well. Their thermometer, however, was an odd one: it is the common custom in this country to scald a fowl before plucking it, in the same manner as we treat a pig, and then the feathers come off very easily: they judged from the comparative facility with which this operation could be performed during the two periods.

† Caldcleugh's Philosoph. Transact. for 1836.

rain never falls, can, I think, only be accounted for by the melting of the snow: yet the mountains which are covered by snow during that season are three or four leagues distant from the springs. I have no reason to doubt the accuracy of my informer, who having lived on the spot for several years, ought to be well acquainted with the circumstance,—which, if true, certainly is very curious: for, we must suppose that the water, being conducted through porous strata to the regions of heat, is again thrown up to the surface by the line of dislocated and injected rock at Cauquenes; and the regularity of the phenomenon would seem to indicate that in this district heated rock occurred at a depth not excessively great.

One day I rode up the valley to the furthest inhabited spot. Shortly above that point, the Cachapual divides into two deep tremendous ravines, which penetrate directly into the great range. I scrambled up a peaked mountain, probably more than six thousand feet high. Here, as indeed every where else, scenes of the highest interest presented themselves. It was by one of these ravines that Pincheira entered Chile, and ravaged the neighbouring country. This is the same man whose attack on an estancia at the Rio Negro I have described. He was a renegade half-cast Spaniard, who collected a great body of Indians together, and established himself by a stream in the Pampas, which place none of the forces sent after him could ever discover. From this point he used to sally forth, and crossing the Cordillera by passes hitherto unattempted, he ravaged the farm-houses, and drove the cattle to his secret rendezvous. Pincheira was a capital horseman, and he made all around him equally good, for he invariably shot any one who hesitated to follow him. It was against this man, and other wandering Indian tribes, that Rosas waged the war of extermination.

September 13th.—We left the baths of Cauquenes, and rejoining the main road, slept at the Rio Claro. From this place we rode to the town of S. Fernando. Before arriving there, the last basin had expanded into a great plain, which

extended so far to the south, that the snowy summits of the more distant Andes were seen, as if above the horizon of the sea. S. Fernando is forty leagues from Santiago; and it was my furthest point southward; for we here turned at right angles towards the coast. We slept at the gold-mines of Yaquil, which are worked by Mr. Nixon, an American gentleman, to whose kindness I was much indebted during the four days I staid at his house.

SEPTEMBER 14TH.—This morning we rode to the mines, which are situated at the distance of some leagues, near the summit of a lofty hill. On the way we had a glimpse of the lake Tagua-tagua, celebrated for its floating islands, which have been described by M. Gay.* They are composed of the stalks of various dead plants intertwined together, and on the surface of which other living ones take root. Their form is generally circular, and their thickness from four to six feet, of which the greater part is immersed in the water. As the wind blows they pass from one side of the lake to the other, and often carry cattle and horses as passengers.

When we arrived at the mine, I was struck by the pale appearance of many of the men, and inquired from Mr. Nixon respecting their condition. The mine is 450 feet deep, and each man brings up about 200 pounds† weight of stone. With this load they have to climb up the alternate notches cut in the trunks of trees, placed in a zigzag line up the shaft. Even beardless young men, eighteen and twenty years old, with little muscular development of their bodies (they are quite naked excepting drawers) ascend with this great load from nearly the same depth. A strong man, who is not accustomed to this labour, perspires most profusely, with merely carrying up his own body. With this very severe labour, they live entirely on boiled beans and bread. They

* Annales des Sciences Naturelles, March, 1833. M. Gay, a zealous and able naturalist, is now occupied in studying every branch of natural history throughout the kingdom of Chile.

† In another mine, as will hereafter be mentioned, I picked out a load by hazard, and weighed it: it was 197 pounds.

would prefer having the latter alone; but their masters, finding they cannot work so hard upon this, treat them like horses, and make them eat the beans. Their pay is here rather more than at the mines of Jajuel, being from 24 to 28 shillings per month. They leave the mine only once in three weeks; when they stay with their families for two days.* One of the rules in this mine sounds very harsh, but answers pretty well for the master. The only method of stealing gold, is to secrete pieces of the ore, and take them out as occasion may offer. Whenever the major-domo finds a lump thus hidden, its full value is stopped out of the wages of all the men; who thus, without they all combine, are obliged to keep watch over each other.

When the ore is brought to the mill, it is ground into an impalpable powder; the process of washing removes all the lighter particles, and amalgamation finally secures the gold dust. The washing, when described, sounds a very simple process; but it is beautiful to see how the exact adaption of the current of water to the specific gravity of the gold, so easily separates the powdered matrix from the metal. The mud which passes from the mills is collected into pools, where it subsides, and every now and then is cleared out, and thrown into a common heap. A great deal of chemical action then commences, salts of various kinds effloresce on the surface, and the mass becomes hard. In the heap which I examined, an angulo-concretionary structure was also superinduced, and what was very remarkable, these pseudo-frag-

* Bad as all the above treatment appears, it is gladly accepted of by the miners; for the condition of the labouring agriculturists is much worse. The wages of the latter are lower, and they live almost exclusively on beans. This poverty must be chiefly owing to the feudal-like system on which the land is tilled. The landowner gives a small plot of ground to the labourer, for building and cultivating, and in return has his services (or that of a proxy) for every day of his life, without any wages. Until a father has a grown up son who can by his labour pay the rent, there is no one, except on chance days, to take care of the patch of ground. Hence extreme poverty is very common among the labouring classes in this country.

ments possessed an even and well-defined slaty structure; but the laminæ were not inclined at any uniform angle. The mud, after having been left for a year or two, and then rewashed, yields gold; and this process may be repeated even six or seven times; but the gold each time becomes less in quantity, and the intervals required (as the inhabitants say to generate the metal) are longer. There can be no doubt that the chemical action, already mentioned, each time liberates fresh gold from some combination. The discovery of a method to effect this before the first grinding, would without doubt raise the value of gold ores many fold.

It is curious to find how the minute particles of gold, after being scattered about, and from not corroding, at last accumulate in some quantity. A short time since a few miners, being out of work, obtained permission to scrape the ground round the house and mill: they washed the earth thus got together, and so procured thirty dollars' worth of gold. This is an exact counterpart of what takes place in nature. Mountains suffer degradation and wear away, and with them the metallic veins which they contain. The hardest rock is worn into impalpable mud, the ordinary metals oxidate, and both are removed; but gold, platina, and a few others, are nearly indestructible, and from their weight, sinking to the bottom, are left behind. After whole mountains have passed through this grinding mill, and have been washed by the hand of nature, the residue becomes metalliferous, and man finds it worth his while to complete the task of separation.

There are some old Indian ruins in this neighbourhood, and I was shown one of the perforated stones which Molina* mentions, as being found in many places in considerable numbers. They are of a circular flattened form, from five to six inches in diameter, and with a hole passing quite through the centre. It has generally been supposed, that

* Molina, Compendio de la Historia, &c. del Reyno de Chile, vol. i., p. 81.

they were used as heads to clubs, although their form does not appear at all well adapted for that purpose. Burchell* states that some of the tribes in Southern Africa dig up roots, by the aid of a pointed stick, the force and weight of which is increased by a round stone with a hole, into which the stick is firmly wedged. It appears probable that the Indians of Chile formerly used some such rude agricultural instrument.

One day, a German collector in natural history, of the name of Renous, called, and nearly at the same time an old Spanish lawyer. I was amused by afterwards hearing the conversation which took place between them. Renous speaks Spanish so well, that the old lawyer mistook him for a fellow-countryman. Renous, alluding to myself, asked him what he thought of the King of England sending out a collector to their country, to pick up lizards and beetles, and to break stones? The old gentleman thought seriously for some time, and then said, "It is not well,—*hay un gato encerrado aqui* (there is a cat shut up here). No man is so rich as to send out people to pick up such rubbish. I do not like it: if one of us were to go and do such things in England, do not you think the King of England would very soon send us out of his country?" And this old gentleman, from his profession, belongs to the better informed and more intelligent classes! Renous himself, two or three years before, left in a house at S. Fernando some caterpillars, under charge of a girl to feed, that they might turn into butterflies. This was rumoured through the town, and at last the Padres and Governor consulted together, and agreed it must be some heresy. Accordingly, when Renous returned, he was arrested.

September 19th.—We left Yaquil, and followed the flat valley, formed like that of Quillota, in which the Rio Tinderidica flows. Even at these few miles south of Santiago the climate is much damper; in consequence there were fine tracks of pasturage, which were not irrigated. (20th.) We fol-

* Burchell's Travels, vol. ii., p. 45.

lowed this valley till it expanded into a great plain, which reaches from the sea to the mountains west of Rancagua. We shortly lost all trees and even bushes; so that the inhabitants are nearly as badly off for firewood as those in the Pampas. Never having heard of these plains, I was much surprised at meeting with such scenery in Chile. The plains belong to more than one series of different elevations, and they are traversed by broad flat-bottomed valleys; both of which circumstances, as in Patagonia, bespeak the gentle retreat of the ocean. In the steep cliffs bordering these valleys, there are some large caves, which no doubt were formed by the waters of the ancient bays and channels. One of these which I visited is celebrated under the name of Cueva del Obispo; having formerly been consecrated. During the day I felt very unwell, and from that time till the end of October did not recover.

September 22d.—We continued to pass over green plains without a tree. The next day we arrived at a house near Navedad, on the sea-coast, where a rich Haciendero gave us lodgings. I stayed here the two ensuing days, and although very unwell, managed to collect from the tertiary formation some marine shells, many of which turn out to be quite new forms. 24th. Our course was now directed towards Valparaiso, which with great difficulty I reached on the 27th, and was there confined to my bed till the end of October. During this time I was an inmate in Mr. Corfield's house, whose kindness to me I do not know how to express.

I will here add a few observations on some of the animals and birds of Chile. The Puma, or South American Lion, is not uncommon. This animal has a wide geographical range; being found from the equatorial forests, throughout the deserts of Patagonia, as far south as the damp and cold latitudes (53° to 54°) of Tierra del Fuego. I have also seen its footsteps in the Cordillera of central Chile, at an elevation of at least 10,000 feet. In La Plata the puma chiefly preys on deer, ostriches, bizcacha, and other small quadrupeds; it

there seldom attacks cattle or horses, and except in most rare cases, as a female having young, is never dangerous to man. In Chile, however, it destroys many young horses and cattle, owing probably to the scarcity of other quadrupeds: I heard, likewise, of two men and a woman who had been killed by them. It is asserted that the puma always kills its prey by springing on the shoulders, and then drawing back the head with one of its paws, until the vertebræ break: I have seen in Patagonia, the skeletons of guanacoes, with their necks thus dislocated.

The puma, after eating its fill, covers the carcass with many large bushes, and lies down to watch it. This habit is often the cause of its being discovered; for the condors wheeling in the air, every now and then descend to partake of the feast, and being angrily driven away, rise all together on the wing. The Chileno Guaso then knows there is a lion watching his prey—the word is given—and men and dogs hurry to the chase. Sir F. Head says that a Gaucho in the Pampas, upon merely seeing some condors wheeling in the air, cried "A lion!" I could never myself meet with any one who pretended to such powers of discrimination. It is asserted, that if a puma has once been betrayed by thus watching the carcass, and has then been hunted, it never resumes this habit; but that having gorged itself, it wanders far away.

The puma is easily killed. In an open country, it is first entangled with the bolas, then lazoed, and dragged along the ground till rendered insensible. At Tandeel (south of the Plata), I was told, that within three months one hundred were destroyed. In Chile they are generally driven up bushes or trees, and are then either shot, or baited to death by dogs. The dogs employed in this chase belong to a particular breed, called Leoneros. They are weak, slight animals, like long-legged terriers, but are born with a particular instinct for this sport. The puma is described as being very crafty: when pursued it often returns on its former track, and then suddenly making a spring on one side, waits there till the

dogs have passed by. It is a very silent animal, uttering no cry even when wounded, and only rarely during the breeding season.

Of birds, two species of the genus *Pteroptochos* (*megapodius* and *albicollis* of Kittlitz) are perhaps the most conspicuous. The former, called by the Chilenos "el Turco," is as large as a fieldfare, to which bird it has some alliance; but its legs are much longer, tail shorter, and beak stronger: its colour is a reddish brown. The turco is not uncommon. It lives on the ground, sheltered among the thickets which are scattered over the dry and sterile hills. With its tail erect, and stilt-like legs, it may be seen every now and then, popping from one bush to another, with uncommon celerity. It really requires little imagination to believe the bird is ashamed of itself, and is aware of its most ridiculous figure. On first seeing it, one is tempted to exclaim, "A vilely stuffed specimen has escaped from some museum, and has come to life again!" It cannot be made to take flight without the greatest trouble, nor does it run, but only hops. The various loud cries which it utters when concealed amongst the bushes, are as strange as its whole appearance. It is said to build its nest in a deep hole beneath the ground. I dissected several specimens: the gizzard, which was very muscular, contained beetles, vegetable fibres, and pebbles. From this character, from the length of legs, scratching feet, membranous covering to the nostrils, short and arched wings, this bird seems to a certain degree to connect the thrushes with the gallinaceous order.

The second species (or *Pt. albicollis*) is allied to the first in its general form. It is called Tapacolo, or "cover your posterior;" and well does the shameless little bird deserve its name; for it carries its tail more than erect, that is, inclined backwards towards its head. It is very common, and frequents the bottoms of hedge-rows, and the bushes scattered over the barren hills, where scarcely another bird can exist. Hence the tapacolo is conspicuous in the ornithology of Chile. In its general manner of feeding, of quickly hopping

out of the thickets and back again, in its desire of concealment, unwillingness to take flight, and nidification, it bears a close resemblance to the turco; but its appearance is not quite so ridiculous. The tapacolo is very crafty: when frightened by any person, it will remain motionless at the bottom of a bush, and will then, after a little while, try with much address to crawl away on the opposite side. It is also an active bird, and continually making a noise: these noises are various and strangely odd; some are like the cooing of doves, others like the bubbling of water, and many defy all similes. The country people say it changes its cry five times in the year—according to some change of season I suppose. I believe these two species of Pteroptochos are only found in central Chile. To the southward, within the damp forest region, two other species supply the place of these lovers of a more sterile land; and a fifth species is common to both districts. On the Patagonian coast a bird allied to them, both in structure and habits, represents this Chilian genus.*

Two species of humming-birds are common, and I have seen a third kind within the Cordillera, at an elevation of about 10,000 feet. *Mellisuga Kingii* is found over a space of 2500 miles on the west coast, from the hot dry country of Lima, to the forests of Tierra del Fuego—where it has been described as flitting about in a snow-storm. In the wooded island of Chiloe, which has an extremely humid climate, this little bird, skipping from side to side amidst the dripping foliage, is perhaps more abundant than almost any other kind. It there very commonly frequents open marshy ground, where a kind of bromelia grows: hovering near the edge of the thick beds, it every now and then dashed in close to the

* It is a remarkable fact, that Molina, though describing in detail all the birds and animals of Chile, never once mentions this genus, the species of which are so common, and so remarkable in their habits. Was he at a loss how to classify them, and did he consequently think that silence was the more prudent course? It is one more instance of the frequency of omission by authors, on those very subjects where it would be least expected.

ground; but I could not see whether it ever actually alighted. At the time of year I refer to, there were very few flowers, and none whatever near the beds of bromelia. Hence I was quite sure they did not live on honey; and on opening the stomach and upper intestine, by the aid of a lens I could plainly distinguish, in a yellow fluid, morsels of the wings of diptera—probably tipulidæ. It is evident that these birds search for minute insects in their winter-quarters under the thick foliage. I opened the stomachs of several specimens, which were shot in different parts of the continent; and in all, remains of insects were so numerous, as often to present a black comminuted mass, as in the stomach of a creeper. In central Chile these birds are migratory: they make their appearance there in autumn, and in the latter end of the month corresponding to our October, they were very common. In the spring they began to disappear, and on the 12th of what would correspond to our March, in the course of a long walk, I saw only one individual. As this species migrates to the southward, it is replaced by the arrival of a larger kind, which will be presently described. I do not believe the small kind breeds in Chile; for, during the summer, their nests were common to the south of that country. The migration of the humming-birds on both the east* and west coast of North America exactly corresponds to what takes place in this southern continent. In both cases they move towards the tropic during the colder parts of the year, and retreat northward before the returning heat. Some, however, remain during the whole year in Tierra del Fuego; and in Northern California,—which in the northern hemisphere has the same relative position which Tierra del Fuego has in the southern,—some, according to Beechey, likewise remain.

The second species (*Trochilus gigas*) is a very large bird, for the delicate family to which it belongs. In the neighbourhood of Valparaiso, during this year, it had arrived in

* Humboldt's Pers. Narr., vol. v., part i., p. 352; Cook's Third Voyage, vol. ii.; and Beechey's Voyage.

numbers, a little before the vernal equinox. It comes from the parched deserts of the north, probably for the purpose of breeding in Chile. When on the wing, the appearance of this bird is singular. Like others of the genus, it moves from place to place with a rapidity which may be compared to that of Syrphus amongst diptera, and Sphinx among moths; but whilst hovering over a flower, it flaps its wings with a very slow and powerful movement, totally different from that vibratory one common to most of the species, which produces the humming noise. I never saw any other bird, where the force of its wings appeared (as in a butterfly) so powerful in proportion to the weight of its body. When hovering by a flower, its tail is constantly expanded and shut like a fan, the body being kept in a nearly vertical position. This action appears to steady and support the bird, between the slow movements of its wings. Although flying from flower to flower in search of food, its stomach generally contained abundant remains of insects, which I suspect are much more the object of its search than honey is. The note of this species, like that of nearly the whole family, is extremely shrill.

CHAPTER XV.

Chiloe—General aspect—Boat excursion — Native Indians — Castro—Large leaves of Gunnera scabra—Tame fox—Ascend San Pedro—Chonos Archipelago—Peninsula of Tres Montes—Granitic range—Lowe's Harbour—Wild potato—Forest—Formation of peat—Myopotamus, otter and mice—Cheucau and barking-bird—Furnarius—Singular character of ornithology—Petrels.

CHILOE AND CHONOS ISLANDS.

NOVEMBER 10TH.—The Beagle sailed from Valparaiso to the southward, for the purpose of surveying the southern part of Chile, the island of Chiloe, and the broken land called the Chonos Archipelago, as far south as the Peninsula of Tres Montes. On the 21st we anchored in the bay of S. Carlos, the capital of Chiloe.

This island is about ninety miles long, with a breadth of rather less than thirty. The land is hilly, but not mountainous, and is every where covered by one great forest, excepting a few scattered green patches, which have been cleared round the thatched cottages. From a distance the view somewhat resembles Tierra del Fuego; but the woods, when seen nearer, are incomparably more beautiful. Many kinds of fine evergreen trees, and plants with a tropical character, here take the place of the gloomy beech of the southern shores. In winter the climate is detestable, and in summer it is only a little better. I should think there are few parts of the world, within the temperate regions, where so much rain falls. The winds are very boisterous, and the sky almost always clouded: to have a week of fine weather is something wonderful. It is even difficult to get a single glimpse of the Cordillera: during our first visit only one opportunity occurred, and that was before sunrise, when the Volcano of Osorno stood out in bold relief; and it was curious

to watch, as the sun rose, the outline gradually fading away in the glare of the eastern sky.

The inhabitants, from their complexion and low stature, appear to have three-fourths of Indian blood in their veins. They are an humble, quiet, industrious set of men. Although the fertile soil, resulting from the decomposition of volcanic rocks, supports a rank vegetation, yet the climate is not favourable to any production which requires much sunshine to ripen it. There is very little pasture for the larger quadrupeds; and in consequence, the staple articles of food are pigs, potatoes, and fish. The people all dress in strong woollen garments, which each family makes for itself, and dyes with indigo of a dark blue colour. The arts, however, are in the rudest state;—as may be seen in their strange fashion of ploughing, their method of spinning, grinding corn, and in the construction of their boats.

The forests are so impenetrable, that the land is nowhere cultivated except near the coast, and on the adjoining islets. Even where roads exist, they are scarcely passable from the soft and swampy state of the soil. The inhabitants, like those of Tierra del Fuego, chiefly move about on the beach, or in boats: in some cases the latter afford the only means of getting from one house to another. Although with plenty to eat, the people are very poor: there is no demand for labour, and consequently the lower orders cannot scrape together money sufficient to purchase even the smallest luxuries. There is also a great deficiency of a circulating medium. I have seen a man bringing on his back a bag of charcoal, with which to buy some trifle, and another a plank to exchange for a bottle of wine. Hence every tradesman must also be a merchant, and again sell the goods which he takes in exchange.

November 24th.—The yawl and whale-boat were sent under the command of Mr. Sulivan, to survey the eastern or inland coast of Chiloe; and with orders to meet the Beagle at the southern extremity of the island; to which point she would proceed by the outside, so as thus to circumnavi-

gate the island. I accompanied this expedition, but instead of going in the boats the first day, I hired horses to take me to Chacao, at the northern extremity of the island. The road followed the coast; every now and then crossing promontories covered by fine forests. In these shaded paths it is absolutely necessary that the whole road should be made of logs of wood, which are squared and placed by the side of each other. From the rays of the sun never penetrating the evergreen foliage, the ground is so damp and soft, that except by such means, neither man nor horse would be able to pass along. I arrived at the village of Chacao, shortly after the tents belonging to the boats had been pitched for the night.

The land in this neighbourhood had been extensively cleared, and there were many quiet and most picturesque nooks in the forest. Chacao was formerly the principal port; but many vessels having been lost, owing to the dangerous currents and rocks in the straits, the Spanish government burnt the church, and thus arbitrarily compelled the greater number of inhabitants to migrate to S. Carlos. In a short time the barefooted son of the governor came down to reconnoitre us. Seeing the English flag hoisted at the yawl's mast-head, he asked, with the utmost indifference, whether it was always to fly at Chacao. In several places, the inhabitants were much astonished at the appearance of men-of-war's boats, and hoped and believed it was the forerunner of a Spanish fleet, coming to recover the island from the patriot government of Chile. All the men in power had, however, been informed of our intended visit, and were exceedingly civil. While we were eating our supper, the governor paid us a visit. He had been a lieutenant-colonel in the Spanish service, but now was miserably poor. He gave us two sheep, and accepted in return two cotton handkerchiefs, some brass trinkets, and a little tobacco.

25TH.—Torrents of rain: we managed, however, to run down the coast as far as Huapi-lenou. The whole of this eastern side of Chiloe has one aspect: it is a plain, broken by valleys, and divided into little islands, and the whole

thickly covered with one impervious blackish-green forest. On the margins there are some cleared spaces, surrounding the high-roofed cottages.

26TH.—The day rose splendidly clear. The volcano of Osorno was spouting out volumes of smoke. This most beautiful mountain, formed like a perfect cone, and white with snow, stands out in front of the Cordillera. Another great volcano, with a saddle-shaped summit, also emitted from its immense crater little jets of steam. Subsequently we saw the lofty-peaked Corcovado—well deserving the name of "el famoso Corcovado." Thus we beheld, from one point of view, three great active volcanoes, each of which had an elevation of about seven thousand feet. In addition to this, far to the south, there were other very lofty cones covered with snow, which although not known to be active, must have been in their origin volcanic. The line of the Andes is not, in this neighbourhood, nearly so elevated as in Chile; neither does it appear to form so perfect a barrier between the regions of the earth. This great range, although running in a direct north and south line, owing to an optical deception, always appeared more or less semicircular; for the extreme peaks being seen standing above the same horizon together with the nearer ones, their much greater distance was not so easily recognised.

When landing on a point to take observations, we saw a family of pure Indian extraction. The father was singularly like York Minster; and some of the younger boys, with their ruddy complexions, might have been mistaken for Pampas Indians. Every thing I have seen convinces me of the close connexion of the different tribes, who nevertheless speak quite distinct languages. This party could muster but little Spanish, and talked to each other in their own tongue. It is a pleasant thing to see the aborigines advanced to the same degree of civilization, however low that may be, which their white conquerors have attained. More to the south we saw many pure Indians: indeed, some of the islands, such as Chauques, &c., have no other inhabitants than such as retain

the Indian surname. In the census of 1832, there were in Chiloe and its dependencies, forty-two thousand souls. The greater number of these appear to be little copper-coloured men, of mixed blood. Eleven thousand actually retain their Indian surname; but it is probable that not nearly all of them are of pure blood. Their manner of life is the same with that of the other poor inhabitants, and they are all Christians: but it is said that they yet retain some strange superstitious ceremonies, and that they pretend to hold communication with the devil in certain caves. Formerly, every one convicted of this offence was sent to the Inquisition at Lima. Many of those people who are not included in the eleven thousand, cannot be distinguished by their appearance from Indians. Gomez, the governor of Lemuy, is descended from noblemen of Spain on both sides, but by constant intermarriages with natives, the present man is an Indian. On the other hand, the governor of Quinchao boasts much of his pure Spanish blood.

We reached at night a beautiful little cove, north of the island of Caucahue. The people here complained of want of land. This is partly owing to their own negligence in not clearing the woods, and partly to restrictions of the government, which makes it necessary before buying ever so small a piece, to pay two shillings to the surveyor, for measuring each quadra (150 yards square), together with whatever price he fixes for the value of the land. After his valuation, the land must be put up three times to auction, and if no one bids more, the purchaser can have it at that rate. All these exactions must be a serious check to clearing the ground, where the inhabitants are so extremely poor. In most countries, forests are removed without much difficulty, by the aid of fire; but in Chiloe, from the damp nature of the climate, and the sort of trees, it is necessary first to cut them down. This is a heavy drawback to the prosperity of Chiloe. In the time of the Spaniards the Indians could not hold land; and a family, after having cleared a piece of ground, might be driven away, and the property seized by

the government. The Chilian authorities are now performing an act of justice, by making retribution to these poor Indians; giving to each man, according to his grade of life, a certain portion of land. The value of uncleared ground is very little. The government gave Mr. Douglas (the present surveyor, who informed me of these circumstances) eight and a half square miles of forest near S. Carlos, in lieu of a debt; and this he sold for 350 dollars, or about seventy pounds sterling.

The two succeeding days were fine, and at night we reached the island of Quinchao. This neighbourhood is the most cultivated part of the Archipelago; for a broad strip of land on the coast of the main island, as well as on many of the smaller adjoining ones, is almost completely cleared. Some of the farm-houses seemed very comfortable. I was curious to ascertain how rich any of these people might be, but Mr. Douglas says that no one can be considered as possessing a regular income. One of the richest landowners might possibly accumulate, in a long industrious life, as much as a thousand pounds sterling; but should this happen, it would all be stowed away in some secret corner; for it is the custom of almost every family to have a jar or treasure-chest buried in the ground.

November 30th.—Early on Sunday morning we reached Castro,—the ancient capital of Chiloe, but now a most forlorn and deserted place. The usual quadrangular arrangement of Spanish towns could be traced, but the streets and plaza were coated with fine green turf, on which sheep were browsing. The church, which stands in the middle, is entirely built of plank, and has a picturesque and venerable appearance. The poverty of the place may be conceived from the fact, that although containing some hundreds of inhabitants, one of our party was unable any where to purchase either a pound of sugar, or an ordinary knife. No individual possessed either a watch or a clock; and an old man, who was supposed to have a good idea of time, was employed to strike the church bell by guess.

The arrival of our boats was a rare event in this quiet, retired corner of the world; and nearly all the inhabitants came down to the beach to see us pitch our tents. They were very civil, and offered us a house; and one man even sent us a cask of cider as a present. In the afternoon we paid our respects to the governor;—a quiet old man, who, in his appearance and manner of life, was scarcely superior to an English cottager. At night heavy rain set in, which was hardly sufficient to drive away from the tents the large circle of lookers on. An Indian family, who had come to trade in a canoe from Caylen, bivouacked near us. They had no shelter during the rain. In the morning, I asked a young Indian, who was wet to the skin, how he had passed the night. He seemed perfectly content, and answered, "Muy bien, senor."

December 1st.—We steered for the island of Lemuy. I was anxious to examine a reported coal-mine, which turned out to be lignite of little value, in the sandstone (probably of an ancient tertiary epoch) of which these islands are composed. When we reached Lemuy we had much difficulty in finding any place to pitch our tents, for it was spring tide, and the land was wooded down to the water's edge. In a short time we were surrounded by a large group of the nearly pure Indian inhabitants. They were much surprised at our arrival, and said one to the other, "This is the reason we have seen so many parrots lately; the cheucau (an odd red-breasted little bird, which inhabits the thick forest, and utters very peculiar noises) has not cried 'beware' for nothing." They were soon anxious for barter. Money was scarcely worth any thing, but their eagerness for tobacco was something quite extraordinary. After tobacco indigo came next in value; then capsicum, old clothes, and gunpowder. The latter article was required for a very innocent purpose: each parish has a public musket, and the gunpowder was wanted for making a noise on their saint or feast days.

The people here live chiefly on shell-fish and potatoes. At certain seasons they catch also, in "corrales" or hedges

under water, many fish which are left on the mud-banks as the tide falls. They occasionally possess fowls, sheep, goats, pigs, horses, and cattle; the order in which they are here mentioned expressing their respective frequency. I never saw any thing more obliging and humble than the manners of these people. They generally began with stating, that they were poor natives of the place, and not Spaniards, and that they were in sad want of tobacco and other comforts. At Caylen, the most southern island, we bought with a stick of tobacco of the value of three-halfpence, two fowls—one of which, the Indian stated, had skin between its toes, and turned out to be a fine duck; and with some cotton handkerchiefs, worth three shillings, we procured three sheep, and a large bunch of onions. The yawl at this place was anchored some way from the shore, and we had fears for her safety during the night. Our pilot, Mr. Douglas, accordingly told the constable of the district, that we always placed sentinels with loaded arms, and not understanding Spanish, if we saw any person in the dark, we should assuredly shoot him. The constable, with much humility, agreed to the perfect propriety of this arrangement, and promised us that no one should stir out of his house during that night.

During the four succeeding days we continued sailing southward. The general features of the country remained the same, but it was much less thickly inhabited. On the large island of Tanqui there was scarcely one cleared spot; the trees on every side extending their branches over the sea-beach. I one day noticed some very fine plants of the panke (*Gunnera scabra*), which somewhat resembles the rhubarb on a gigantic scale, growing on the sandstone cliffs. The inhabitants eat the stalks, which are subacid, and tan leather with the roots, and prepare a black die from them. The leaf is nearly circular, but deeply indented on its margin: I measured one which had a diameter of nearly eight feet, and therefore a circumference of no less than twenty-four! The stalk is rather more than a yard high, and each plant

sends out four or five of these enormous leaves—presenting together a very noble appearance.

DECEMBER 6TH.—We reached Caylen, called "el fin del Cristiandad." In the morning we stopped for a few minutes at a house on the northern end of Laylec, which was the extreme point of South American Christendom, and a miserable hovel it was. The latitude is 43° 10′, which is two degrees further south than the Rio Negro on the Atlantic coast. These extreme Christians were very poor, and, under the plea of their situation, begged some tobacco. As a proof of the poverty of these Indians, I may mention that, shortly before this, we had met a man who had travelled three days and a half on foot, and had as many to return, for the sake of recovering the value of a small axe, and a few fish. How very difficult it must be to buy the smallest article, when such trouble is taken to recover so small a debt!

In the evening we reached the island of S. Pedro, where we found the Beagle at anchor. In doubling the point, two of the officers landed to take a round of angles with the theodolite. A fox, of a kind said to be peculiar to the island, and very rare in it, and which is an undescribed species, was sitting on the rocks. He was so intently absorbed in watching their manœuvres, that I was able, by quietly walking up behind, to knock him on the head with my geological hammer. This fox, more curious or more scientific, but less wise, than the generality of his brethren, is now mounted in the museum of the Zoological Society.

We staid three days in this harbour; on one of which Captain FitzRoy, with a party, attempted to ascend to the summit of San Pedro. The woods here had rather a different aspect from those on the northern parts of the island. The rock also being micaceous slate, there was no beach, but the steep sides dipped directly beneath the water. The general aspect in consequence was more like that of Tierra del Fuego than of Chiloe. In vain we tried to gain the summit: he forest was so impenetrable that no one, who has not beheld it, can imagine so entangled a mass of dying and dead

trunks. I am sure that often, for more than ten minutes together, our feet never touched the ground, and we were frequently ten or fifteen feet above; it so that the seamen as a joke called out the soundings. At other times we crept one after another on our hands and knees, under the rotten trunks. In the lower part of the mountain, noble trees of the winter's bark, and a laurel like the sassafras with fragrant leaves, and others, the names of which I do not know, were matted together by a trailing bamboo or cane. Here we were more like fishes struggling in a net than any other animal. On the higher parts, brushwood takes the place of larger trees, with here and there a red cedar or an alerce pine. I was also pleased to see, at an elevation of a little less than 1000 feet, our old friend the southern beech. They were, however, poor stunted trees; and I should think this must be nearly their northern limit. We ultimately gave up the attempt in despair.

December 10th.—The yawl and whale-boat, with Mr. Sulivan, proceeded on their survey, but I remained on board the Beagle, which the next day left S. Pedro for the southward. On the 13th we ran into an opening in the southern part of Guayatecas, or the Chonos Archipelago; and it was fortunate we did so, for on the following day a storm, worthy of Tierra del Fuego, raged with its wonted fury. White massive clouds were piled up against a dark blue sky, and across them black ragged sheets of vapour were rapidly driven. The successive mountain-ranges appeared like dim shadows; and the setting sun cast on the woodland a yellow gleam, much like that produced by the flame of spirits of wine on a man's countenance. The water was white with the flying spray; and the wind lulled and roared again through the rigging. It was a most ominous, sublime scene. During a few minutes there was a bright rainbow, and it was curious to observe the effect of the spray, which, being carried along the surface of the water, changed the ordinary semicircle into a ring. A band of prismatic colours was continued from both feet of the common arch, across the bay, close to the vessel's side; thus forming a distorted, but very nearly entire circle.

We staid here three days. The weather continued bad; but this did not much signify, for the surface of the land in all these islands is all but impassable. The coast is so very rugged, that to attempt to walk in that direction requires continued scrambling up and down, over the sharp rocks of mica slate; and as for the woods—our faces, hands, and shin-bones all bore witness to the maltreatment we received in merely attempting to penetrate their forbidden recesses.

December 18th.—We stood out to sea. On the 20th we bade farewell to the south, and with a fair wind turned the ship's head northward. From Cape Tres Montes we sailed pleasantly along the lofty weather-beaten coast; which is remarkable for the bold outline of its hills, and the thick covering of forest—even on the almost precipitous flanks. The next day a harbour was discovered, which on this dangerous coast might be of great utility to a distressed vessel. It can easily be recognised by a hill 1600 feet high, which is even more perfectly conical than the famous sugar-loaf at Rio de Janeiro. The next day, after anchoring, I succeeded in reaching the summit of this hill. It was a laborious undertaking, for the sides were so steep, that in some parts it was necessary to use the trees as ladders: there were also several extensive brakes of the Fuchsia covered with its beautiful drooping flowers, but very difficult to crawl through. In these wild countries it gives much delight, to gain the summit of any mountain. There is an indefinite expectation of meeting something very strange, which, however often it may be balked, never failed with me to recur on each successive attempt. Every one must know the feeling of triumph and pride which a grand view from a height communicates to the mind. In these little frequented countries there is also joined to it some vanity, that you perhaps are the first man who ever stood on this pinnacle or admired this view.

A strong desire is always felt to ascertain, whether any body has previously visited the place. A bit of wood with a nail in it is picked up and studied, as if it were covered with hieroglyphics. Possessed with this feeling, I was much in-

terested by finding, on a wild part of the coast, a bed made of grass beneath a ledge of rock. Close by it there had been a fire, and the man had used an axe. The fire, bed, and situation, showed the dexterity of an Indian; but he could scarcely have been an Indian; for the race is in this part extinct, owing to the Catholic desire of making at one blow Christians and Slaves. I had at the time some misgivings (though they afterwards were proved to have been groundless) that the solitary man, who had made his bed on this wild spot, must have been some poor shipwrecked sailor, who, in trying to travel up the coast, had here lain himself down for his dreary night.

December 28th.—The weather continued very bad, but it at last permitted us to proceed with the survey. The time hung heavy on our hands, as it always did when we were delayed from day to day by successive gales of wind. In the evening another harbour was discovered, where we anchored. Directly afterwards a man was seen waving his shirt; and a boat was sent which brought back two seamen. A party of six had run away from an American whaling vessel, and had landed a little to the southward in a boat, which was shortly afterwards knocked to pieces by the surf. They had now been wandering up and down the coast for fifteen months, without knowing which way to go, or where they were. What a singular piece of good fortune it was that this harbour was now discovered! Had it not been for this one chance, they might have wandered till they had grown old men, and at last have perished on this wild coast. Their sufferings had been very great, and one of their party had lost his life, by falling from the cliffs. They were sometimes obliged to separate in search of food, and this explained the bed of the solitary man. Considering what they had undergone, I think they had kept a very good reckoning of time; though they had lost four days, by making this the 24th instead of the 28th.

December 30th.—We anchored in a snug little cove at the foot of some high hills, near the northern extremity of

Tres Montes. After breakfast the next morning, a party ascended one of these mountains, which had an altitude of 2400 feet. The scenery was remarkable. The chief part of the range was composed of grand, solid, abrupt masses of granite, which appeared as if they had been coeval with the beginning of the world. The granite is capped with slaty gneiss, and this in the lapse of ages has been worn into strange finger-shaped points. These two formations, thus differing in their outlines, agree in being almost destitute of vegetation. This barrenness had to our eyes a still stranger appearance, from our having been so long accustomed to the sight of an almost universal forest of dark green trees. I took much delight in examining the structure of these mountains. The complicated and lofty ranges bore a noble aspect of durability,—equally profitless, however, to man and to all other animals. Granite to the geologist is classic ground: from its wide-spread limits, and its beautiful and compact texture, few rocks have been more early recognised. Granite has given rise, perhaps, to more discussion concerning its origin than any other formation. We generally see it constituting the fundamental rock, and, however formed, we know it is the deepest layer in the crust of this globe, to which man has been able to penetrate. The limit of man's knowledge in any subject possesses a high interest, which is perhaps increased by its close neighbourhood to the realms of imagination.

January 1st, 1835.—The new year is ushered in, with the ceremonies proper to it in these regions. She lays out no false hopes; a heavy N. W. gale, with steady rain, bespeaks the rising year. Thank God, we are not destined here to see the end of it, but hope then to be in the Pacific, where a blue sky tells one there is a heaven—a something beyond the clouds above our heads.

The N. W. winds prevailing for the next four days, we only managed to cross a great bay, and then anchored in another secure harbour. I accompanied the captain in a boat to the head of a deep creek. On the way the number

of seals which we saw was quite astonishing; every bit of flat rock, and parts of the beach, were covered with them. They appeared to be of a loving disposition, and lay huddled together, fast asleep, like so many pigs; but even pigs would be ashamed of their dirt, and of the foul smell which came from them. Each herd was watched by the patient but inauspicious eyes of the turkey-buzzard. This disgusting bird, with its bald scarlet head, formed to wallow in putridity, is very common on the west coast, and their attendance on the seals shows that they are dependant on their mortality. We found the water (probably only that of the surface) nearly fresh; this was caused by the number of torrents, which, in the form of cascades, came tumbling over the bold granite mountains into the sea. The fresh water attracts the fish, and these bring many terns, gulls, and two kinds of cormorant. We saw also a pair of the beautiful black-necked swans, and several small sea-otters, the fur of which is held in such high estimation. In returning we were again amused by the impetuous manner in which the heap of seals, old and young, tumbled into the water as the boat passed. They did not remain long under, but rising, followed us with outstretched necks, expressing great wonder and curiosity.

7TH.—Having run up the coast, we anchored near the northern end of the Chonos Archipelago, in Lowe's Harbour, where we remained a week. The islands were here, as in Chiloe, composed of a stratified littoral deposit of soft sandstone with shingle; and the vegetation in consequence was beautifully luxuriant. The woods came down to the sea-beach, just in the same manner as an evergreen shrubbery over a gravel walk. We also enjoyed from the anchorage a splendid view of four great snowy cones of the Cordillera, beginning with the saddle-topped volcano, next "el famoso Corcovado," and then two others to the southward. The range itself had in this latitude so little elevation, that few parts of it appeared above the line of the neighbouring islets. We found here a party of five men

from Caylen, "el fin del Cristiandad," who had most adventurously crossed the open space of sea which separates Chonos from Chiloe, in their miserable boat-canoe, for the purpose of fishing. These islands will, in all probability, in a short time become peopled, like those adjoining the coast of Chiloe.

Humboldt,* in his Essay on the Kingdom of New Spain, has given a most interesting discussion on the history of the common potato. He believes that the plant described by Molina,† under the name of *maglia*, is the original stock of this useful vegetable, and that it grows in Chile in its native soil. He supposes that thence it was transported by the Indian population to Peru, Quito, New Granada, and the whole Cordillera, from 40° south to 5° north. He observes that it is a remarkable circumstance, and in accordance with all records respecting the course of the stream of American population, that previously to the Spanish conquest, it was unknown in Mexico. Among the Chonos Islands, a wild potato grows in abundance, which in general habit is even more closely similar to the cultivated kind than is the *maglia* of Molina.

These potatoes grow near the sea-beach, in thick beds, on a sandy, shelly soil, wherever the trees are not too close together. In the middle of January they were in flower, but the tubers were small, and few in number; especially in those plants which grew in the shade, and had the most luxuriant foliage. Nevertheless, I found one which was of an oval form, with one diameter two inches in length. The raw bulbs had precisely the smell of the common potato of England, but when cooked they shrunk, and became watery and insipid. They had not a bitter taste, as, according to Molina, is the case with the Chilian kind; and they could be eaten with safety. Some plants measured

* Humboldt's New Spain, book iv., chap. ix.

† Molina's Chile, Spanish edition, vol. i., p. 136.

from the ground to the tip of the upper leaf, not less than four feet.

So very close is the general resemblance with the cultivated species, that it is necessary to show that they have not been imported. The simple fact of their growth on the islands, and even small rocks, throughout the Chonos Archipelago, which has never been inhabited, and very seldom visited, is an argument of some weight. But the circumstance of the wildest Indian tribes being well acquainted with the plant, is stronger. Mr. Lowe, a very intelligent and active sealer, informs me, that on showing some potatoes to the naked savages in the Gulf of Trinidad (lat. 50°), they immediately recognised them, and calling them "Aquina," wanted to take them away. The savages also pointed to a place where they grew; which fact was subsequently verified. The Indians of Chiloe, belonging to another tribe, also give them a name in their own language. The simple fact of their being known and named by distinct races, over a space of four or five hundred miles on a most unfrequented and scarcely known coast, almost proves their native existence. Professor Henslow, who has examined the dried specimens which I brought home, says that they are the same with those described by Mr. Sabine* from Valparaiso, but that they form a variety which by some botanists has been considered as specifically distinct. It is remarkable that the same plant should be found on the sterile mountains of central Chile, where a drop of rain does not fall for more than six months, and within the damp forests of the southern islands. From what we know of the habits of the potato, this latter situation would appear more congenial than the former, as its birthplace.

In the central parts of the Chonos Archipelago, in lat. 45° 30′, the forest has assumed very much the same charac-

* Horticultural Transact., vol. v., p. 249. Mr. Caldcleugh sent home two tubers, which being well manured, even the first season produced numerous potatoes and an abundance of leaves.

ter which is found along the whole west coast for 600 miles to Cape Horn. The arborescent grass of Chiloe has here ceased to exist; while the beech of Tierra del Fuego both grows to a good size, and forms a considerable proportion of the wood; not, however, in the same exclusive manner as it does further to the southward. Cryptogamic plants here find a most congenial climate. In the neighbourhood of the Strait of Magellan, I have before remarked that the country appears too cold and wet to allow of their arriving at perfection; but in these islands, within the forest, the number of species, and great abundance of mosses, lichens, and small ferns, is quite extraordinary.* In Tierra del Fuego trees grow only on the hill-sides; every level piece of land being invariably covered by a thick bed of peat; but in Chiloe the same kind of situation supports the most luxuriant forest. Here, within the Chonos Archipelago, the nature of the climate more closely approaches that of the southern, than that of the northern, of these two countries. Nearly every patch of level ground is covered by two species of plants (*Astelia pumila* of Brown,† and *Donatia magellanica*), which by their joint decay compose a thick bed of elastic peat.

In Tierra del Fuego, above the region of woodland, the former of these eminently sociable plants is the chief agent in the production of peat. Fresh leaves are always succeeding one to the other, round the central tap root; the lower ones soon decay; and in tracing a root downward in the peat, the leaves (yet holding their position) can be observed passing through every stage of decomposition, till the whole becomes blended in one confused mass. The Astelia is assisted by few other plants; here and there a small creeping one (*Myrtus nummularia*), with a woody stem like our

* By sweeping with my insect-net, I procured from these situations a considerable number of minute insects of the family of Staphylinidæ, and others allied to Pselaphus, and minute Hymenoptera. But the most characteristic family in number of both individuals and species, throughout the more open parts of Chiloe and Chonos, is that of the Telephoridæ.

† *Anthericum trifarium* of Solander.

cranberry, but with a sweet berry; another (*Empetrum rubrum*) like our heath, and a third (*Juncus grandiflorus*) a rush; are nearly the only ones that grow on the swampy surface. These plants, though possessing a very close general resemblance to the English kinds, are botanically different. In the more level parts of the country, the surface of the peat is broken up into little pools of water, which stand at different heights, and appear as if artificially excavated. Small streams of water, flowing under ground, complete the disorganization of the vegetable matter, and consolidate the whole.

The climate of the southern part of America appears particularly favourable to the production of peat. In the Falkland Islands, almost every kind of plant, even the coarse grass which covers the whole surface of the island, becomes converted into this substance. I was at first at a loss to imagine how so much peat had been formed; but the conversion of the grass at once explains it. I observed that even some bones of cattle, strewed on the surface, were nearly covered up by the decaying matter at the foot of the blades of withered grass. Scarcely any situation checks its growth; it overhangs the banks of running streams, and encroaches on the piles of loose angular fragments of quartz rock. Some of the beds are of considerable thickness, even as much as twelve feet: the peat in the lower part is earthy, and completely altered, and when dry, becomes so solid that it ignites with difficulty. No doubt, although every plant lends its aid in the process, yet the Astelia is the most efficient. It is rather a singular circumstance, as being so very different from what occurs in Europe, that no kind of moss forms by its decay any portion of the peat in South America.

With respect to the northern limit at which the climate allows of that peculiar kind of slow decomposition which is necessary for the production of peat, I believe that in Chiloe (lat. 41° to 42°), although there is much swampy ground, no well-characterized substance of this nature

occurs. But in the Chonos Islands, three degrees further southward, we have seen that it is abundant. On the eastern coast in La Plata (lat. 35°), I was told by a Spanish resident (who had visited Ireland), that he had often sought for this substance, but had never been able to find any. He showed me, as the nearest approach to it which he had discovered, a black peaty soil, so penetrated with roots as to allow of an extremely slow and imperfect combustion.

The zoology of these broken islets of the Chonos Archipelago, is, as might have been expected, very poor. Of quadrupeds, two aquatic kinds are common. The *Myopotamus Coipus* (like a beaver, but with a round tail) is well known from its fine fur, which is an object of trade, throughout the tributaries of La Plata. It here, however, exclusively frequents salt water; which same circumstance has been mentioned, as sometimes occurring with the great rodent, the Capybara. A small sea-otter is very numerous. This animal does not feed exclusively on fish, but, like the seals, draws a large supply from a small red crab, which swims in shoals near the surface of the water. Mr. Bynoe saw one in Tierra del Fuego eating a cuttle-fish; and at Lowe's Harbour another was killed, in the act of carrying to its hole a large volute; and this was the only specimen of that shell which was procured. At one place I caught in a trap a singular little mouse; it appeared common on several of the islets, but the Chilotans at Lowe's Harbour said that it was not found in all. What a succession of chances,* or what changes of level, must have been brought into play, thus to spread these small animals throughout this broken archipelago!

In all parts of Chiloe and Chonos, two very strange birds occur, which have many points of affinity with the Turco

* Many rapacious animals bring their prey alive to feed their young. Are there any instances on record of such a habit among owls or hawks? If so, in the course of centuries, every now and then, one might escape from the young birds. Some such agency is wanted, to account for the distribution of the smaller gnawing animals on islands near to each other.

and Tapacolo. One is called by the inhabitants "Cheucau" (*Pteroptochos rubecula*). It frequents the most gloomy and retired spots within the damp forests. Sometimes, although its cry may be heard close at hand, let a person watch ever so attentively, he will not see the cheucau; at other times, let him stand motionless, and the red-breasted little bird will approach within a few feet, in the most familiar manner. It then busily hops about the entangled mass of rotting canes and branches, with its little tail cocked upwards. I opened the gizzard of some specimens: it was very muscular, and contained hard seeds, buds of plants, and vegetable fibres, mixed with small stones. The cheucau is held in superstitious fear by the Chilotans, on account of its strange and varied cries. There are three very distinct kinds,—one is called "chiduco," and is an omen of good; another, "huitreu," which is extremely unfavourable; and a third, which I have forgotten. These words are given in imitation of its cries, and the natives are in some things absolutely governed by them. The Chilotans assuredly have chosen a most comical little creature for their prophet.

An allied species, but rather larger, is called by the natives "Guid-guid" (*Hylactes Tarnii* of King, and *Pteroptochos* of Kittlitz), and by the English the barking-bird. This latter name is well given; for I defy any one at first to feel certain that a small dog is not yelping somewhere in the forest. Just as with the cheucau, a person will sometimes hear the bark close by, but in vain may endeavour, by watching, and with still less chance by beating the bushes, to see its author; yet at other times the guid-guid fearlessly comes near. Its manner of feeding and its general habits are very similar to those of the cheucau. Both species are said to build their nests close to the ground, amongst the rotten branches. The ground being so extremely wet, is a good reason why they do not burrow holes, like the northern species. Besides the cheucau and guid-guid, there is another species, but it is not very common. Moreover, the bird which has been men-

tioned in Tierra del Fuego, under the title of a black wren (*Scytalopus fuscus* of Gould), appears, in its skulking habits, odd cries, and place of resort, and likewise in some points of structure, to be closely related to this singular genus.

On the coast,* a small dusky-coloured bird (a *Furnarius* allied to *fuliginosus*) is very common. It is remarkable from its quiet and very tame habits. It lives entirely on the sea-beach, and there (as well as sometimes on the floating kelp), picks up small sea-shells and crabs; thus supplying the place of a sandpiper. Besides these birds, only a few others inhabit this broken land. In my rough notes I describe the strange noises, which although frequently heard within these gloomy forests, yet scarcely disturb the general silence. The yelping of the guid-guid, and the sudden whew-whew of the cheucau, sometimes come from afar, and sometimes from close at hand;—the little wren occasionally adds its cry;—the creeper follows the intruder, screaming and twittering;—the humming-bird may be seen every now and then darting from side to side, and emitting, like an insect, its shrill chirp;—lastly, from the top of some lofty tree, the indistinct but plaintive note of the white-tufted tyrant-flycatcher may be noticed.

From the great preponderance in most countries of certain kinds of birds, such as the finches, one feels at first surprised at meeting with such peculiar forms, above enumerated, as the commonest birds in any district. In central Chile two of them, namely the *Synallaxis* and *Scytalopus*, occur, although most rarely. When finding, as in this case, any animal which seems to play so insignificant a part in the great scheme of nature, one is apt to wonder why a distinct species

* I may mention as a proof of how great a difference there is between the seasons of the wooded and the open parts of the coast, that on September 20th, in lat. 34°, these birds had young ones in the nest, while among the Chonos Islands, three months later in the summer, they were only laying; the difference in latitude between these two places being about 700 miles.

should have been created. But it should always be recollected, that in some other country perhaps it is an essential member of society, or at some former period may have been so. If America south of 37° should be sunk beneath the waters of the ocean, the *Synallaxis* and *Scytalopus* might continue to exist in central Chile for a long period, but it is very improbable that their numbers would increase. We should then see a case, which must inevitably have happened with very many animals.

These southern seas are frequented by several species of Petrels. The largest kind, *Procellaria gigantea*, or nelly, (quebrantahuesos, or break-bones, of the Spaniards) is a common bird, both in the inland channels and on the open sea. In its habits and manner of flight there is a very close resemblance with the albatross, and as with the latter bird, a person may watch it for hours together without seeing on what it feeds, so is it with this petrel. The "break-bones" is, however, a rapacious bird,* for it was observed by some of the officers at Port St. Antonio chasing a diver. The bird tried to escape both by diving and flying, but was continually struck down, and at last killed by a blow on its head. At Port St. Julian, also, these great petrels were seen killing and devouring young gulls.

A second species (*Puffinus cinereus*†), which is common to Europe, Cape Horn, and the coast of Peru, is of a much smaller size than the *gigantea*, but, like it, of a dirty black colour. It generally frequents the inland sounds in very large flocks: I do not think I ever saw so many birds of any other sort together, as I once saw of these behind the island of Chiloe. Hundreds of thousands flew in an irregular line, for several hours in one direction. When part of the flock settled on the water, the surface was blackened, and a noise proceeded from them, as of human beings talking in the dis-

* The Spaniards who named it were probably aware of this, for "quebrantahuesos" means properly an osprey.

† I am indebted to Mr. Gould for naming these birds, and for kindly furnishing me with much information respecting them.

tance. At this time the water was in parts coloured by clouds of small crustacea. At Port Famine, every morning and evening, a long band of these birds continued to fly, with extreme rapidity, up and down the central parts of the channel. I opened the stomach of one (which I shot with some difficulty, for they were rather wary), and it contained a small fish, and seven good-sized, prawn-like crabs.

There are several other species of petrels, but I will only mention one other kind, the *Puffinuria Berardii*, which offers one more example of those extraordinary cases, of a bird evidently belonging to one well-marked family, yet both in its habits and structure allied to a very distinct tribe. This bird never leaves the quiet inland sounds. When disturbed it dives to a distance, and on coming to the surface, with the same movement takes wing. After flying for a space in a direct course, by the rapid movement of its short wings, it drops, as if struck dead, and dives again. The form of the beak and nostrils, length of foot, and even colouring of the plumage, show that this bird is a petrel: at the same time, its short wings and consequent little power of flight, its form of body and shape of tail, its habits of diving, and the absence of a hind toe to its foot, and its choice of situation, make it doubtful whether its relationship is not equally close with the auks as with the petrels. It would undoubtedly be mistaken for one of the former, when seen either on the wing, or when diving and quietly swimming about the retired channels of Tierra del Fuego.

CHAPTER XVI.

San Carlos, Chiloe—Osorno in eruption—Ride to Castro and Cucao—Impenetrable forests—Valdivia—Apple-trees—Ride to Llanos—Indians—Earthquake—Concepcion—Great earthquake—Effects of wave—Rocks fissured—Appearance of the former towns—Water in the bay black and boiling—Direction of vibration—Stones displaced—Cause of great waves—Permanent elevation of land—Great lake of fluid rock beneath crust of the globe—Connexion of volcanic phenomena—Slow elevation of mountain chain, cause of earthquakes.

CHILOE AND CONCEPCION.

On January the 15th we sailed from Lowe's Harbour, and three days afterwards anchored a second time in the bay of S. Carlos in Chiloe. On the night of the 19th the volcano of Osorno was in activity. At midnight the sentry observed something like a large star; from which state the bright spot gradually increased in size till about three o'clock, when a very magnificent spectacle was presented. By the aid of a glass, dark objects, in constant succession, were seen, in the midst of a great red glare of light, to be thrown upwards and to fall down again. The light was sufficient to cast on the water a long bright reflection. By the morning the volcano* had resumed its tranquillity.

Large masses of molten matter seem very commonly to be cast out of the igneous vents, in this part of the Cordillera. I was assured, that when the Corcovado is in eruption, great masses projected upwards are seen to burst in the air, and to assume fantastical forms, such as trees and other bodies. One may form an idea of the immense size of these bodies, when it is stated that they have been seen from the high land

* In another work I shall have occasion to refer to this eruption, which is connected with one of the grandest series of volcanic phenomena on record.

behind S. Carlos, which is distant no less than ninety-three miles from the Corcovado.

Captain FitzRoy being anxious that some bearings should be taken on the outer coast of Chiloe, it was planned that Mr. King and myself should ride to Castro, and thence across the island to the Capella de Cucao, situated on the west coast. Having hired horses and a guide, we set out on the morning of the 22d. We had not proceeded far, before we were joined by a woman and two boys, who were bent on the same journey. Every one on this road acts on a "hail fellow well met," fashion; and one may here enjoy the privilege, so rare in South America, of travelling without firearms.

At first, the country consists of a succession of hills and valleys. Nearer to Castro it becomes very level, but is still some height above the sea. The road itself is a curious affair: it consists in its whole length, with the exception of very few parts, of great logs of wood, which are either broad and placed longitudinally, or narrow and transversely. In summer the road is not very bad: but in winter, when the wood is rendered slippery from rain, travelling is exceedingly difficult. At that time of the year, the ground on each side becomes a morass, and is often overflowed: hence it is necessary that the longitudinal logs should be fastened down by transverse poles, which are pegged on each side into the earth. These pegs render a fall from a horse dangerous; as the chance of alighting on one of them is not small. It is remarkable, however, how active custom has made the Chilotan horses. In crossing bad parts, where the logs have been displaced, they skipped from one to the other, almost with the quickness and certainty of a dog. On either hand the road is bordered by the lofty forest-trees, with their bases matted together by the canes. When occasionally a long reach of this avenue could be observed, it presented a curious scene of uniformity: the white line of logs, narrowing in perspective, became hidden by the gloomy forest, or it terminated in a zigzag which ascended some steep hill.

Although the distance from S. Carlos to Castro is only twelve leagues in a straight line, the formation of the road must have been a great labour. I was told that several people had formerly lost their lives in attempting to cross the forest. The first who succeeded was an Indian, who cut his way through the canes in eight days, and reached S. Carlos. He was rewarded by the Spanish government with a grant of land. During the summer, many of the Indians wander about the forests (but chiefly in the higher parts, where the woods are not quite so thick) in search of the half wild cattle which live on the leaves of the cane, and certain trees. It was one of these huntsmen who by chance discovered, a few years since, an English vessel, which had been wrecked on the outer coast. The crew were beginning to fail in provisions, and it is not probable that, without the aid of this man, they would have been able to have extricated themselves from these scarcely penetrable woods. As it was, one seaman died on the march, from fatigue. The Indians in these excursions steer by the sun; so that if there is a continuance of cloudy weather, they cannot travel.

The day was beautiful, and the number of trees which were in full flower perfumed the air; yet even this could scarcely dissipate the effect arising from the gloomy dampness of the forest. Moreover, the many dead trunks that stand like skeletons, never fail to give to these primeval woods a character of solemnity which is wanting in those of countries long civilized. Shortly after sunset we bivouacked for the night. Our female companion, who was rather good-looking, belonged to one of the most respectable families in Castro: she rode, however, astride, and without shoes or stockings. I was surprised at the total want of pride shown by her and her brother. They brought food with them, but at all our meals sat watching Mr. King and myself whilst eating, till we were fairly shamed into feeding the whole party. The night was cloudless; and while lying in our beds, we enjoyed the sight (and it is a high enjoyment) of the multitude of stars which illumined the darkness of the forest.

JANUARY 23D.—We rose early in the morning, and reached the pretty quiet town of Castro by two o'clock. The old governor had died since our last visit, and in his place a Chileno was acting. We had a letter of introduction to Don Pedro. We found him exceedingly hospitable and kind, and with a degree of disinterestedness which is more common in La Plata than on this side of the continent. The next day Don Pedro procured us fresh horses, and offered to accompany us himself. We proceeded to the south; generally following the coast, and passing through several hamlets, each with its large barn-like chapel, built of wood. Near Castro we saw a remarkably pretty waterfall: it was very small, but the water fell in a single sheet into a large circular basin, around which stately trees, from 100 to 120 feet high, cast a dark shade. At Vilipilli, Don Pedro asked the commandant to give us a guide to Cucao. The old gentleman offered to come himself; but for a long time he would not believe that any thing could induce two Englishmen to go to such an out of the way place as Cucao. We thus were accompanied by the two greatest aristocrats in the country; as was plainly to be seen in the manner of all the poorer Indians towards them.

At Chonchi, we struck off across the island, and followed intricate winding paths, sometimes passing through magnificent forests, and then opening into pretty cleared spots, abounding with corn and potato crops. In this undulating woody country, partially cultivated, there was something which reminded me of the wilder parts of England, and therefore had to my eye a most fascinating aspect. At Vilinco, which is situated on the borders of the lake of Cucao, only a few fields are cleared; and all the inhabitants appear to be Indians. This lake is twelve miles long, and runs in an east and west direction. From local circumstances, the sea-breeze blows very regularly during the day, and during the night it falls calm. This has given rise to strange exaggerations: for the phenomenon, as described to us at S. Carlos, was quite a prodigy.

The road to Cucao was so very bad, that we determined to embark in a *periagua*. The commandant, in the most authoritative manner, ordered six Indians to get ready to pull us over, without deigning to tell them whether they would be paid. The periagua is a strange rough boat, but the crew were still stranger; I doubt if six uglier little men ever got into a boat together. They pulled, however, very well and cheerfully: the stroke-oar gabbled Indian, and uttered strange cries, much after the fashion of a pig-driver when driving his pigs. We started with a light breeze against us, but yet reached, before late at night, the Capella de Cucao. The country on each side of the lake was one unbroken forest.

In the same periagua with us, a cow was embarked. To get so large an animal into a small boat appears at first a difficulty; but the Indians managed it in a minute. They brought the cow alongside the boat, which was heeled towards her; then placing two oars under her belly, with their ends resting on the gunwale, by the aid of these levers they fairly tumbled the poor beast, heels over head, into the bottom of the boat, and then lashed her down with ropes. At Cucao, we found an uninhabited hovel (which is the residence of the padre when he pays this Capella a visit), where, lighting a fire, we cooked our supper, and were very comfortable.

The district of Cucao is the only inhabited part on the whole west coast of Chiloe. It contains about thirty or forty Indian families, who are scattered along four or five miles of the shore. They are very much secluded from the rest of Chiloe, and have scarcely any sort of commerce, except sometimes in a little oil, which they get from seal-blubber. They are pretty well dressed, in clothes of their own manufacture, and they have plenty to eat. They seemed, however, discontented, yet humble to a degree which it was quite painful to witness. The former feeling is, I think, chiefly to be attributed to the harsh and authoritative manner in which they are treated by their rulers. Our companions, although so very civil to us,

behaved to the poor Indians as if they had been slaves, rather than free men. They ordered provisions and the use of their horses, without ever condescending to say how much, or indeed whether the owners should be paid at all. In the morning, being left alone with these poor people, we soon ingratiated ourselves by presents of cigars and maté. A lump of white sugar was divided between all present, and tasted with the greatest curiosity. The Indians ended all their complaints by saying, "and it is only because we are poor Indians, and know nothing; but it was not so when we had a king."

The next day, after breakfast, we road to Punta Huantamó, a few miles to the northward. The road lay along a very broad beach, on which, even after so many fine days, a terrible surf was breaking. I was assured that after a heavy gale, the roar can be heard at night even at Castro, a distance of no less than twenty-one sea miles, across a hilly and wooded country. We had some difficulty in reaching the point, owing to the intolerably bad paths; for every where in the shade the ground soon becomes a perfect quagmire. The point itself is a bold rocky hill. It is covered by a plant allied, I believe, to Bromelia, and called by the inhabitants Chepones. In scrambling through the beds, our hands were very much scratched. I was amused by observing the precaution our Indian guide took, in turning up his trousers, thinking that they were more delicate than his own hard skin. This plant bears a fruit, in shape like an artichoke, in which a number of seed-vessels are packed; these contain a pleasant sweet pulp, here much esteemed. I saw at Lowe's Harbour, the Chilotans making chichi, or cider, with this fruit: so true is it, as Humboldt remarks, that almost every where man finds means of preparing some kind of beverage from the vegetable kingdom. The savages, however, of Tierra del Fuego, and I believe of Australia, have not advanced thus far in the arts.

The coast to the northward of Punta Huantamó is exceedingly rugged and broken, and is fronted by many breakers,

on which the sea is eternally roaring. Mr. King and myself were anxious to return, if it had been possible, on foot along this coast; but even the Indians said it is quite impracticable. We were told that men have crossed by striking directly through the woods from Cucao to S. Carlos, but never by the coast. On these expeditions, the Indians carry with them only toasted corn, and of this they eat sparingly twice a day.

26TH.—Re-embarking in the periagua, we returned across the lake, and then mounted our horses. The whole of Chiloe took advantage of this week of unusually fine weather, to clear the ground by burning. In every direction volumes of smoke were curling upwards. Although the inhabitants were so assiduous in setting fire to every part of the wood, yet I did not see a single fire which they had succeeded in making extensive. We dined with our friend the commandant, and did not reach Castro till after dark.

The next morning we started very early. After having ridden for some time, we obtained from the brow of a steep hill an extensive view (and it is a rare thing on this road) of the great forest. Over the horizon of trees, the volcano of Corcovado, and the great flat-topped one to the northward, stood out in proud pre-eminence; scarcely another peak in the long range showed its snowy top. I hope it will be long before I forget this farewell view of the magnificent Cordillera of Chiloe. At night we bivouacked under a cloudless sky, and the next morning reached S. Carlos. We arrived on the right day, for before evening heavy rain commenced.

FEBRUARY 4th.—Sailed from Chiloe. During the last week I made several short excursions. One was to examine a great bed of oyster and Venus shells, of the same kind now living in the neighbouring bay, but elevated 350 feet (measured by the barometer) above the level of the sea. From among these shells large forest-trees were growing. Another ride was to P. Huechucucuy. I had with me a guide who knew the country far too well; for he would

pertinaciously tell me the Indian name for every little point, rivulet, and creek. In the same manner as in Tierra del Fuego, the Indian language appears singularly well adapted for attaching names to the most trivial divisions of the land. I believe every one was glad to say farewell to Chiloe. Yet if we could forget the gloom and ceaseless rain of winter, Chiloe might pass for a charming island. There is, also, something very attractive in the simplicity and humble politeness of all the poor inhabitants.

We steered along shore to the northward, but owing to thick weather, did not reach Valdivia till the night of the eighth. The external features of the whole line of country were the same with the central parts of Chiloe. The forest was nowhere cleared away. On the sea-coast bold rocky points projected, but further inland the older formations were covered up by plains, belonging to geological periods of no great antiquity. The next morning, after anchoring in the fine harbour of Valdivia, the boat proceeded to the town, which is distant about ten miles. We followed the course of the river, occasionally passing a few hovels, and patches of ground cleared out of the otherwise unbroken forest; and sometimes meeting a canoe with an Indian family. The town is situated on the low banks of the stream, and is so completely buried in a wood of apple-trees, that the streets are merely paths in an orchard.

I have never seen any country where apple-trees appeared to thrive so well as in this damp part of South America. On the borders of the roads there were many young trees which had evidently planted themselves. In Chiloe, the inhabitants possess a marvellously short method of making an orchard. At the lower part of almost every branch, small, conical, brown, wrinkled points project: these are always ready to change into roots, as may sometimes be seen, where any mud has been accidentally splashed against the tree. A branch as thick as a man's thigh is chosen, and is cut off just beneath a group of these points; all the smaller branches are lopped off, and it is then placed about two feet

deep in the ground: the operation is performed in the earliest part of the spring. During the succeeding summer, the stump throws out very long shoots, and sometimes even bears fruit. I was shown one which had produced as many as twenty-three apples, but this was thought very unusual. The ensuing summer, the first year shoots throw out others, and by the third season the stump is changed (as I have myself seen) into a well-wooded tree, loaded with an abundance of fruit. I understand there is one kind of apple-tree in England, which can be treated in a similar manner; but I believe the rapidity of growth, and at the same time production of fruit, is very inferior to that of the trees in Chiloe. An old man near Valdivia illustrated his motto, "Necessidad es la madre del invencion," by giving an account of the several useful things he manufactured from his apples. After making cider, he extracted from the refuse a white and very finely-flavoured spirit: by another process he procured a sweet treacle, or, as he called it, honey. He likewise showed us wine derived from the same fruit. The children and pigs seemed almost to live, during this season of the year, in the orchards.

February 11th.—I set out with a guide on a short ride, in which, however, I managed to see singularly little, either of the geology of the country, or of its inhabitants. There is not much cleared land near Valdivia: after crossing a river at the distance of a few miles, we entered the forest, and then passed only one miserable hovel, before reaching our sleeping-place for the night. The short difference in latitude, of 150 miles, has given another aspect to the forest, compared to that of Chiloe. This is owing to a slightly different proportion in the kinds of trees. The evergreens do not appear to be quite so numerous; and the forest in consequence is coloured by a brighter and more lively green. In the same manner as in Chiloe, the lower parts are matted together by canes. Here also another kind of the same family (resembling the bamboo of Brazil, and about twenty feet in height), grows in clusters, and ornaments the banks of some of the streams

in a very pretty manner. It is with this plant that the Indians make their chuzos, or long tapering spears. Our resting-house was so dirty that I preferred sleeping outside. The first night on these journeys is generally an uncomfortable one, because one's body is not accustomed to the tickling and biting of the fleas. I am sure, in the morning, there was not a space on my legs of the size of a shilling, which had not its little red mark, where the flea had feasted.

12TH.—We continued to ride through the uncleared forest; only occasionally meeting an Indian on horseback, or a troop of fine mules bringing alerce planks and corn from the southern plains. In the afternoon one of the horses knocked up: we were then on the brow of a hill, which commanded a fine view of the Llanos. The view of these open plains was very refreshing, after being hemmed in and buried amongst a wilderness of trees. The uniformity of a forest soon becomes very wearisome. This west coast makes me remember with pleasure the free, unbounded plains of Patagonia; yet with the true spirit of contradiction, I cannot forget how sublime is the silence of the forest. The Llanos are the most fertile and thickly-peopled parts of the country; as they possess the immense advantage of being nearly free from trees. Before leaving the forest we crossed some flat little lawns, around which single trees encroached, in the same manner as in an English park. It is curious how frequently a plain seems hostile to the growth of trees. Humboldt found much difficulty in endeavouring to account for their presence in certain parts of South America, and their absence in other parts. It appears to me, that the level state of the surface very frequently determines this point; but the cause of its doing so I do not know. In the case of Tierra del Fuego, the deficiency of trees on level ground is probably owing to the accumulation of too much moisture in such situations. But to the northward of Maldonado, in Banda Oriental, where we have a fine undulating country, with streams of water (which are themselves fringed with

woods), the circumstance appears to me, as I have before stated, of very difficult explanation.

On account of the tired horse, I determined to stop close by, at the Mission of Cudico; to the friar of which I had a letter of introduction. Cudico is an intermediate district between the forest and the Llanos. There are a good many cottages, with patches of corn and potatoes, nearly all belonging to Indians. The tribes dependant on Valdivia are "reducidos y cristianos." The Indians further northward, about Arauco and Imperial, are still very wild and not converted; but they all have much intercourse with the Spaniards. The padre said that the Christian Indians did not much like coming to mass, but that otherwise they show respect for religion. The greatest difficulty is in making them observe the ceremonies of marriage. The wild Indians take as many wives as they can support; and a cacique will sometimes have more than ten. On entering his house, the number may be told by that of the separate fires. This plan must be a good one to prevent quarrelling. Each wife lives a week in turn with the cacique; but all are employed in weaving ponchos, &c., for his advantage. To be the wife of a cacique is an honour much sought after by the Indian women.

The men of all the tribes wear a coarse woollen poncho; but those south of Valdivia wear short trousers, and those northward a petticoat, like the chilipa of the Gauchos. All have their long hair bound by a scarlet fillet round their heads; but otherwise they are uncovered. These Indians are good-sized men; their cheek-bones are very prominent, and in general appearance they resemble the great American family to which they belong; but their physiognomy seemed to me to be slightly different from that of any other tribe which I had before seen. Their expression is generally grave and even austere, and possesses much character: this may pass either for honest bluntness, or fierce determination. The long black hair, the grave and much-lined features, and the dark complexion, called to my mind old

portraits of James the First; but very likely the resemblance may be imaginary. On the road we met with none of that humble politeness so universal in Chiloe. Some gave their "mari mari" (good morning) with promptness, but the greater number did not seem inclined to offer any salute. This independence of manners is probably a consequence of their long wars, and the repeated victories which they alone of all the tribes in America have gained over the Spaniards.

I spent the evening very pleasantly, talking with the padre. He was exceedingly kind and hospitable; and coming from Santiago, had contrived to surround himself with some few comforts. Being a man of some little education, he bitterly complained of the total want of society. With no particular zeal for religion, no business or pursuit, how completely must this man's life be wasted! Finding nothing which tempted me either to stay or to proceed, the next day we set out on our return through the forest. We met on the road seven very wild Indians. Amongst them were some caciques, who had been receiving a yearly stipend, which is paid to some who have long remained faithful. They were fine-looking men, and they rode one after the other, with most gloomy faces. An old cacique, who headed them, had been, I suppose, more excessively drunk than the rest, for he seemed both extremely grave and very crabbed. Shortly before this, two Indians joined us, who were travelling from a distant mission to Valdivia, concerning some lawsuit. One was a good-humoured old man, but from his wrinkled beardless face looked more like an old woman than a man. I frequently presented both of them with cigars; and though ready to receive them, and I dare say grateful, they would hardly condescend to thank me. A Chilotan Indian would have taken off his hat and given his "Dios le page!" (May God repay you!) — The travelling was very tedious, both from the badness of the roads, and from the number of great fallen trees, which it was necessary either to leap over, or to avoid by making long circuits. We slept

on the road, and next morning reached Valdivia, whence I proceeded on board.

A few days afterwards I crossed the bay with a party of officers, and landed near the fort called Niebla. The buildings were in a most ruinous state, and the gun-carriages quite rotten. Mr. Wickham remarked to the commanding officer, that with one discharge they would certainly all fall to pieces. The poor man, trying to put a good face upon it, gravely replied, "No, I am sure, sir, they would stand two!" The Spaniards must have intended to have made this place impregnable. There is now lying in the middle of the courtyard a little mountain of mortar, which rivals in hardness the rock on which it is placed. It was brought from Chile, and cost seven thousand dollars. The revolution having broken out, prevented its being applied to any purpose, and now it remains a monument of the fallen greatness of Spain.

I wanted to go to a house about a mile and a half distant; but my guide said it was quite impossible to penetrate the wood in a straight line. He offered, however, to lead me, by following obscure cattle-tracks, the shortest way; the walk, nevertheless, took no less than three hours! This man is employed in hunting strayed cattle; yet, well as he must know the woods, he was not long since lost for two whole days, and had nothing to eat. These facts convey a good idea of the impracticability of the forests of these countries. A question often occurred to me—How long does any vestige of a fallen tree remain? This man showed me one which a party of fugitive royalists had cut down fourteen years ago; and taking this as a criterion, I should think a bole a foot and a half in diameter would in thirty years present a mere ridge of mould.

February 20th.—The day has been memorable in the annals of Valdivia, for the most severe earthquake experienced by the oldest inhabitant. I happened to be on shore, and was lying down in the wood to rest myself. It came on suddenly, and lasted two minutes; but the time appeared

much longer. The rocking of the ground was most sensible. The undulations appeared to my companion and myself to come from due east; whilst others thought they proceeded from south-west; which shows how difficult it is in all cases to perceive the direction of these vibrations. There was no difficulty in standing upright, but the motion made me almost giddy. It was something like the movement of a vessel in a little cross ripple, or still more like that felt by a person skating over thin ice, which bends under the weight of his body.

A bad earthquake at once destroys the oldest associations: the world, the very emblem of all that is solid, has moved beneath our feet like a crust over a fluid;—one second of time has conveyed to the mind a strange idea of insecurity, which hours of reflection would never have created. In the forest, as a breeze moved the trees, I only felt the earth tremble, but saw no consequences from it. Captain FitzRoy and the officers were at the town during the shock, and there the scene was more awful; for although the houses, from being built of wood, did not fall, yet they were so violently shaken that the boards creaked and rattled. The people rushed out of doors in the greatest alarm. I feel little doubt that it is these accompaniments which cause that horror of earthquakes, experienced by all those who have thus seen as well as felt their effects. Within the forest it was a deeply interesting, but by no means an awe-exciting phenomenon. The tides were very curiously affected. The great shock took place at the time of low water; and an old woman who was on the beach told me, that the water flowed very quickly, but not in big waves, to high-water mark, and then as quickly returned to its proper level; this was also evident by the line of wet sand. This same kind of quick but quiet movement in the tide happened a few years since at Chiloe, during a slight earthquake, and created much causeless alarm. In the course of the evening there were other weaker shocks, all of which seemed to produce in the harbour the most complicated currents, and some of great strength.

22D.—We sailed from Valdivia, and on the 4th of March, entered the harbour of Concepcion. While the ship was beating up to the anchorage, which is distant several miles, I was landed on the island of Quiriquina. The mayor-domo of the estate quickly rode down to tell us the terrible news of the great earthquake of the 20th;—"that not a house in Concepcion, or Talcuhano, (the port) was standing; that seventy villages were destroyed; and that a great wave had almost washed away the ruins of Talcuhano." Of this latter fact I soon saw abundant proof; the whole coast being strewed over with timber and furniture, as if a thousand great ships had been wrecked. Besides chairs, tables, bookshelves, &c., in great numbers, there were several roofs of cottages, which had been drifted in an almost entire state. The storehouses at Talcuhano had burst open, and great bags of cotton, yerba, and other valuable merchandise, were scattered about on the shore. During my walk round the island, I observed that numerous fragments of rock, which, from the marine productions adhering to them, must recently have been lying in deep water, had been cast up high on the beach. One of these was a slab six feet by three, and about two feet thick.

The island itself as plainly showed the overwhelming power of the earthquake, as the beach did that of the consequent great wave. The ground was fissured in many parts, in north and south lines; which direction perhaps was caused by the yielding of the parallel and steep sides of the narrow island. Some of the fissures near the cliffs were a yard wide: many enormous masses had already fallen on the beach; and the inhabitants thought, that when the rains commenced, even much greater slips would happen. The effect of the vibration on the hard primary slate, which composes the foundation of the island, was still more curious: the superficial parts of some narrow ridges were as completely shivered, as if they had been blasted by gunpowder. This effect, which was rendered very evident by the fresh fractures and displaced soil, must, during earthquakes, be confined to near the sur-

face, for otherwise there would not exist a block of solid rock throughout Chile. This limited action is not improbable, as it is certain, that the surface of any body, when vibrating, is in a different condition from the central parts. It is, perhaps, owing to this same reason, that earthquakes do not cause quite such terrific havoc within deep mines, as would at first have been expected. I believe this convulsion has been more effectual in lessening the size of the island of Quiriquina, than the ordinary wear and tear of the weather and the sea during the course of an entire century.

The next day I landed at Talcuhano, and afterwards rode to Concepcion. Captain FitzRoy has given so detailed and accurate an account of the earthquake, that it is almost useless for me to say any thing on the subject; but I will extract a few passages from my journal. Both towns presented the most awful yet interesting spectacle I ever beheld. To a person who had formerly known the places, it possibly might have been still more impressive; for the ruins were so mingled together, and the whole scene possessed so little the air of a habitable place, that it was scarcely possible to imagine its former appearance or condition. The earthquake commenced at half-past eleven in the forenoon. If it had happened in the middle of the night the greater number of the inhabitants (which in this one province amount to many thousands),* instead of less than a hundred, must have perished. In Concepcion, each house, or row of houses, stood by itself, a heap or line of ruins; but in Talcuhano, owing to the great wave, little more than one layer of bricks, tiles, and timber, with here and there part of a wall left standing, could be distinguished. From this circumstance, Concepcion, although not so completely desolated, was a more terrible, and if I may so call it, picturesque sight. The first shock was very sudden. The invariable practice among the residents in

* Miers estimates them at 40,000; but the towns in some of the other provinces were likewise overthrown.

these provinces, of running out of doors at the first trembling of the ground, alone saved them. The mayor-domo at Quiriquina told me, that the first notice he received of the earthquake, was finding both the horse he rode, and himself, rolling together on the ground. Rising up, he was again thrown down. He also told me that some cows, which were standing on the steep sides of the island, were rolled into the sea. The great wave, however, was far more destructive in this respect: on one low island near the head of the bay, seventy animals were washed off and drowned. It is generally thought that this has been the worst earthquake ever recorded in Chile; but as the very bad ones occur only after long intervals, this cannot easily be known; nor indeed would a much more severe shock have made any great difference, for the ruin is now complete.

After viewing Concepcion, I cannot understand how the greater number of inhabitants escaped unhurt. The houses in many parts fell outwards; thus forming in the middle of the streets little hillocks of brickwork and rubbish. Mr. Rous, the English consul, told us that he was at breakfast when the first movement warned him to run out. He had scarcely reached the middle of the courtyard, when one side of his house came thundering down. He retained presence of mind to remember, that if he once got on the top of that part which had already fallen, he should be safe. Not being able, from the motion of the ground, to stand, he crawled up on his hands and knees; and no sooner had he ascended this little eminence, than the other side of the house fell in, the great beams sweeping close in front of his head. With his eyes blinded, and his mouth choked with the cloud of dust which darkened the sky, at last he gained the street. As shock succeeded shock, at the interval of a few minutes, no one dared approach the shattered ruins; and no one knew whether his dearest friends and relations might not be perishing from the want of help. The thatched roofs fell over the fires, and flames burst forth in all parts. Hundreds knew

themselves to be ruined, and few had the means of providing food for the day. Can a more miserable and fearful scene be imagined?

Earthquakes alone are sufficient to destroy the prosperity of any country. If, for instance, beneath England, the now inert subterranean forces should exert those powers which most assuredly in former geological ages they have exerted, how completely would the entire condition of the country be changed! What would become of the lofty houses, thickly-packed cities, great manufacturies, the beautiful public and private edifices? If the new period of disturbance were first to commence by some great earthquake in the dead of the night, how terrific would be the carnage! England would at once be bankrupt; all papers, records, and accounts would from that moment be lost. Government being unable to collect the taxes, and failing to maintain its authority, the hand of violence and rapine would go uncontrolled In every large town famine would be proclaimed, pestilence and death following in its train.

Captain FitzRoy has given an account of the great wave, which, travelling from seaward, burst over Talcuhano. In the middle of the bay it was seen as one unbroken swell of the watér; but on each side, meeting with resistance, it curled over, and tore up cottages and trees as it swept onwards with overwhelming force. At the head of the bay it is easy to imagine the fearful line of white breakers which three times rushed over, and almost obliterated, the ruins of the former town. Pools of salt water yet remained in the streets; and children, making boats with old tables and chairs, appeared as happy as their parents were miserable. It was, however, exceedingly interesting to observe how active and cheerful all appeared, after their heavy misfortune. It was remarked with much truth, that from the destruction being universal, no one individual was humbled more than another, or could suspect his friends of coldness; and this latter effect is perhaps the most grievous one of the loss of wealth. Mr. Rous, and a large party whom he kindly took

under his protection, lived for the first week in a garden beneath some apple-trees. At first they were as merry as if it had been a picnic; but soon afterwards heavy rain caused much discomfort, for they were absolutely without shelter.

In Captain FitzRoy's paper it is said that two explosions, one like a column of smoke, and another like the blowing of a great whale, were seen in the bay of Concepcion. The water also appeared every where to be boiling; and it "became black, and exhaled a most disagreeable sulphureous smell." I am informed by Mr. Alison, that during the earthquake of 1822 these last-mentioned circumstances occurred in the bay of Valparaiso. The two great explosions in the first case must no doubt be connected with deep-seated changes; but the bubbling water, its black colour and fetid smell, the usual concomitants of a severe earthquake, may, I think, be attributed to the disturbance of mud containing organic matter in decay. In the bay of Callao, during a calm day, I noticed, that as the ship dragged her cable over the bottom, its course was marked by a line of bubbles.

The lower orders in Talcuhano thought that the earthquake was caused by some old Indian women, who two years ago having been offended, stopped the volcano of Antuco. This silly belief is curious, because it shows that experience has taught them to observe the constant relation between the suppressed activity of volcanoes, and the trembling of the ground. It was necessary to apply the witchcraft to the point where their knowledge stopped; and this was the closing of the volcanic vent. This saying is the more odd in this particular instance, because the result of Captain FitzRoy's investigation was to discountenance the belief that Antuco (whatever might have been the case with the volcanoes further northward) was any way affected.

The town of Concepcion was built in the usual Spanish fashion, with all the streets running at right angles to each other. One set ranged S.W. by W. and N.E. by E., and the other N.W. by N. and S.E. by S. The walls in the former direction certainly stood better than those in the

other. Captain FitzRoy* has likewise remarked, that the greater number of the masses of brickwork were thrown down towards the N.E. Both these circumstances perfectly agree with the general idea of the undulation having come from the S.W.; in which quarter subterranean noises were also sometimes heard. It is evident on this supposition, that the N.W. and S.E. walls, being nearly coincident with the line of undulation (or with the crests of the successive waves), would be much more likely to fall than those which had their extremities presented towards the point whence the vibration proceeded; for, in the first case, the whole wall would be thrown at the same moment out of its perpendicular. This may be illustrated by placing books edgewise on a carpet, and then, after the manner suggested by Michell, imitating the undulations of an earthquake: it will be found, that they fall with more or less readiness, according to their direction. The fissures in the ground, though not uniform, generally had a S.E. and N.W. direction;† and therefore they corresponded to the lines of principal flexure. Bearing in mind all these circumstances, which so clearly point to the S.W. as the chief focus of disturbance, it is a very interesting fact that the island of S. Maria,† situated in that quarter, was during the general uplifting of the land (to which I shall presently refer) raised to nearly three times the altitude of any other part of the coast.

The different resistance offered by the walls, according to their direction, was well exemplified in the case of the cathedral. The side which fronted the N.E. presented a grand pile of ruins, in the midst of which door-cases and masses of timber stood up, as if floating in a stream. Some of the angular blocks of brickwork were of great dimensions; and they had been rolled to a distance on the level plaza, like fragments of rock round the base of some high moun-

* Sketch of Surveying Voyages of Adventure and Beagle by Captain FitzRoy, Royal Geograph. Journal, vol. vi., p. 320.

† Ditto, p. 327, *et passim*.

tain. The side walls, though exceedingly fractured, yet remained standing; but the vast buttresses (at right angles to them, and therefore parallel to the walls that fell) were in many cases cut clean off, as if by a chisel, and hurled to the ground.

Some square ornaments on the coping of these same walls were moved by the earthquake into a diagonal position. The buttresses of the church of La Merced, at Valparaiso, and some heavy pieces of furniture in the rooms, were similarly affected by the shock of 1822.* Mr. Lyell † has also given a drawing of an obelisk in Calabria, of which the separate stones were partially turned round. In these instances, the displacement at first appears to be owing to a vorticose movement beneath each point thus affected; but such can hardly be the case. May it not be caused by a tendency in each stone to arrange itself in some particular position, with respect to the lines of vibration, — in a manner somewhat similar to pins on a sheet of paper, or on a board, when it is shaken? Generally speaking, arched doorways or windows stood much better than any other kind of building. Nevertheless, a poor lame old man, who had been in the habit, during trifling shocks, of crawling to a certain doorway, was this time crushed to pieces.

I have not attempted to give any detailed description of the appearance of Concepcion, for I feel it is quite impossible to convey the mingled feelings with which one beholds such a spectacle. Several of the officers visited it before me, but their strongest language failed to communicate a just idea of the desolation. It is a bitter and humiliating thing to see works, which have cost men so much time and labour, overthrown in one minute; yet compassion for the inhabitants is almost instantly forgotten, from the interest excited in finding that state of things produced in a moment of time, which one is accustomed to attribute to a succession of ages. In my

* Miers's Chile, vol. i., p. 392.

† Lyell's Principles of Geology, chap. xv., book ii.

opinion, we have scarcely beheld since leaving England, any other sight so deeply interesting.

In almost every severe earthquake which has been described, the neighbouring waters of the sea are said to have been greatly agitated. The disturbance seems generally, as in the case of Concepcion, to have been of two kinds: first, at the instant of the shock, the water swells high up on the beach, with a gentle motion, and then as quietly retreats; secondly, some little time afterwards, the whole body of the sea retires from the coast, and then returns in great waves of overwhelming force. The first and less regular movement seems to be an immediate consequence of the earthquake differently affecting a fluid and a solid, so that their respective levels are slightly deranged. But the second case is a far more important phenomenon, and at first appears of less easy explanation. In reading accounts of earthquakes, and especially of those on the west coast of America, as collated from various authors by Sir W. Parish,* it is certain that the first great movement of the waters has been that of retiring. Several hypotheses† have been invented to explain this fact. Some have supposed it owing to a vertical oscillation in the land, the water retaining its level: but this can hardly happen, even on a moderately shoal coast; for the water near the land must partake of the motion of the bottom. Moreover, as Mr. Lyell has urged, a change of level in the land will not account for movements in the sea, of a similar nature, affecting islands distant from the line of uplifted coast. This occurred at Madeira during the famous Lisbon earthquake. Juan Fernandez also offers a parallel instance; for the sea was disturbed there much in the same manner as on the coast of Chile.

The whole phenomenon, it appears to me, is due to a common undulation in the water, proceeding from a line or point of

* Sir W. Parish had the kindness to lend me the original manuscript, which was read before the Geological Society, March 5th, 1835.

† Lyell's Geology, book ii., ch. xvi.

disturbance, some little way distant. If the waves sent off from the paddles of a steam-vessel be watched breaking on the sloping shore of a still river, the water will be seen first to retire two or three feet, and then to return in little breakers, precisely analogous to those consequent on an earthquake. From the oblique direction in which the waves are sent off from the paddles, the vessel has proceeded a long way ahead, before the undulation reaches the shore; and hence it is at once manifest, that this movement bears no relation to the actual displacement of the fluid from the bulk of the vessel. Indeed, it seems a general circumstance, that in all cases where the equilibrium of an undulation is thus destroyed, the water is drawn from the resisting surface to form the advancing breaker.* Considering then a wave produced by an earthquake as an ordinary undulation proceeding from some point or line in the offing, we can see the cause, first of its occurrence some time after the shock; secondly, of its affecting the shores of the mainland and of outlying islets in a uniform manner—namely, the water retiring first, and then returning in a mountainous breaker; and lastly, of its size being modified (as appears to be the case) by the form of the neighbouring coast. For instance Talcuhano and Callao are situated at the head of great shoaling bays, and they have always suffered from this phenomenon; whereas, the town of Valparaiso, which is seated close on the border of a profound ocean, though shaken by the severest earthquakes, has never been overwhelmed by one of these terrific deluges. On this view, we have only to imagine, in the case of Concepcion, a point of disturbance in the bottom of the sea in a south-west direction, whence the wave was seen to travel, and where the land was elevated to a greater height than any other part,—and the whole phenomenon will be explained.

It is probable that near every coast, the chief line of dis-

* I am indebted to Mr. Whewell for explaining to me the probable movements on the shore, of an undulation of which the equilibrium has been destroyed.

turbance would be situated at that distance in the offing, where the fluid which was most agitated, from overlying the shallow bottom near the land, joined on to that part which covered the depths (but slightly moved) of the ocean. In all distant parts of the coast the small oscillations of the sea, both at the moment of the great shock, and during the lesser following ones, would be confounded with the undulation propagated from the focus of disturbance, and hence the series of movements would be undistinguishable.

The most remarkable effect (or perhaps speaking more correctly, cause) of this earthquake was the permanent elevation of the land. Captain FitzRoy having twice visited the island of Santa Maria, for the purpose of examining every circumstance with extreme accuracy, has brought a mass of evidence in proof of such elevation, far more conclusive than that on which geologists on most other occasions place implicit faith. The phenomenon possesses an uncommon degree of interest, from this particular part of the coast of Chile having previously been the theatre of several earthquakes of the worst class. It is almost certain, from the altered soundings, together with the circumstance of the bottom of the bay near Penco, consisting of hard stone, that there has been an uplifting to the amount of four fathoms, since the famous convulsion of 1751. With this additional instance fresh before us, we may assume as probable, according to the principles laid down by Mr. Lyell,* other small successive elevations, and may fearlessly maintain that the problem of the raised shells,† recorded by Ulloa, is explained.

Some of the consequences which may be deduced from the phenomena connected with this earthquake are most important in a geological point of view; but in the present work I cannot do more than simply allude to the results. Although it is known that earthquakes have been felt over enormous

* Lyell's Geology, book ii., chap. xvi.

† I saw these shells in very great quantities on the flanks of the island of Quiriquina.

spaces, and strange subterranean noises likewise heard over nearly equal areas, yet few cases are on record of volcanoes, very far distant from each other, bursting out at the same moment of time. In this instance, however, at the same hour when the whole country around Concepcion was permanently elevated, a train of volcanoes situated in the Andes, in front of Chiloe, instantaneously spouted out a dark column of smoke, and during the subsequent year continued in uncommon activity. It is, moreover, a very interesting circumstance, that, in the immediate neighbourhood, these eruptions entirely relieved the trembling ground, although at a little distance, and in sight of the volcanoes, the island of Chiloe was strongly affected. To the northward, a volcano burst out at the bottom of the sea adjoining the island of Juan Fernandez, and several of the great chimneys in the Cordillera of central Chile commenced a fresh period of activity. We thus see a permanent elevation of the land, renewed activity through habitual vents, and a submarine outburst, forming parts of one great phenomenon. The extent of country throughout which the subterranean forces were thus unequivocally displayed, measures 700 by 400 geographical miles. From several considerations, which I have not space here to enter on, and especially from the number of intermediate points whence liquefied matter was ejected, we can scarcely avoid the conclusion, however fearful it may be, that a vast lake of melted matter, of an area nearly doubling in extent that of the Black Sea, is spread out beneath a mere crust of solid land.

The elevation of the land to the amount of some feet during these earthquakes, appears to be a paroxysmal movement, in a series of lesser and even insensible steps, by which the whole west coast of South America has been raised above the level of the sea. In the same manner, the most violent explosion from any volcano is merely one in a series of lesser eruptions: and we have seen that both these phonomena, which are in so many ways related, are parts of one common action, only modified by local circum-

stances. With respect to the cause of the paroxysmal convulsion in particular portions of the great area which is simultaneously affected, it can be shown to be extremely probable, that it is owing to the giving way of the superincumbent strata, (and this giving way probably is a consequence of the tension from the general elevation) and their interjection by fluid rock—one step in the formation of a mountain chain. On this view we are led to conclude, that the unstratified mass forming the axis of any mountain, has been pumped in when in a fluid state, by as many separate strokes as there were earthquakes. For instance, in the case of Concepcion, during the few months subsequent to the great shock, upwards of three hundred tremours of the ground were felt, each of which indicated a fresh fracture, and injection of the fluid stone. It is a case precisely analogous to what happens in all bad eruptions, which are invariably followed by a succession of smaller ones: the difference is, that in the volcano the lava is ejected, while in the formation of a mountain chain it is injected. This view of the extremely gradual elevation of a line of mountains, will alone explain the difficulty (which, as far as I am aware, has never been attempted to be solved) of the axis consisting of rock which has become solid under the pressure of the superincumbent strata, while yet these same strata, in their present inclined and vertical positions, cannot possibly cover more than a small portion of that axis.

CHAPTER XVII.

Valparaiso—Passage of Andes by Portillo pass—Sagacity of mules—Mountain torrents—Mines, how discovered—Marine alluvium in valleys—Effect of snow on surface—Geology, fossil shells, double range, two periods of elevation—Red snow—Winds on the crest—Snow thawing in pinnacles—Dry and clear atmosphere—Electricity—Pampas—Zoology of opposite sides of Andes—Uniformity of Patagonia—Locusts—Great bugs—Mendoza—Uspallata—Silicified trees in vertical position—Indian ruins—Change of climate—Earthquake arching bed of river—Cumbre—Valparaiso.

PASSAGE OF CORDILLERA.

March 7th, 1835.—We staid only three days at Concepcion, and then sailed for Valparaiso. The wind being northerly, we only reached the mouth of the harbour of Concepcion before it was dark. Being very near the land, and a fog coming on, the anchor was dropped. Presently a large American whaler appeared close alongside of us; and we heard the Yankee swearing at his men, to make them keep quiet, whilst he listened where the breakers were. Captain FitzRoy hailed him in a loud clear voice, to anchor where he then was. The poor man must have thought the voice came from the shore: such a Babel of cries issued at once from the ship—every one hallooing out, "Let go the anchor! veer cable! shorten sail!" It was the most laughable thing I ever heard. If the ship's crew had been all captains, and no men, there could not have been a greater uproar of orders. We afterwards found that the mate stuttered. I suppose all hands were assisting him in giving his orders.

On the 11th we anchored at Valparaiso; and two days afterwards I set out on an excursion to cross the Cordillera. I proceeded to Santiago, where Mr. Caldcleugh most kindly

assisted me in every possible way, in making the little preparations which were necessary. In this immediate part of Chile there are two passes across the Andes to Mendoza, and the plains on the opposite side. The one most commonly used, namely, that of Aconcagua, or Uspallata, is situated some way to the northward of the capital: the other, called the Portillo, is to the southward, and less distant. The latter is, however, rather more lofty, and from the double chain, more dangerous during a snow-storm. For these reasons it is but little used, especially late in the season.

March 18th.—We set out for the Portillo pass. Leaving Santiago we crossed the wide burnt-up plain on which that city stands, and in the afternoon arrived at the Maypo, one of the principal rivers in Chile. The valley, at the point where it enters the first Cordillera, is bounded on each side by lofty barren mountains; and although not broad, it is very fertile. Numerous cottages were surrounded by vines, and by orchards of apple, nectarine, and peach trees; the boughs of the latter breaking with the weight of the beautiful ripe fruit.

In the evening we passed the custom-house, where our luggage was examined. The frontier of Chile is better guarded by the Cordillera, than by the waters of the sea. There are very few valleys which lead to the central ranges, and, except by these, the mountains are far too steep and lofty for any beast of burden to pass over them. The custom-house officers were very civil; which was perhaps partly owing to the passport which the President of the republic had given me; but I must also express my admiration at the natural politeness of almost every Chileno. In this instance the contrast with the same class of men in most other countries was strongly marked. I may mention an anecdote with which I was much pleased at the time. We met near Mendoza a little and very fat negress, riding astride on a mule. She had a *goître* so enormous, that it was scarcely possible to avoid gazing at her for a moment; but my two companions almost instantly, by way of apology,

made the common salute of the country, by taking off their hats. Where would one of the lower classes in Europe have shown such feeling politeness to a poor and miserable object of a degraded race?

At night we slept at a cottage. Our manner of travelling was delightfully independent. In the inhabited parts we bought a little firewood, hired pasture for the animals, and bivouacked in the corner of the same field with them. Carrying an iron pot, we cooked and ate our supper under the cloudless sky, and knew no trouble. My companions were Mariano Gonzales, who had formerly accompanied me, and an "arriero," with his ten mules and a "madrina."

The madrina (or godmother) is a most important personage. She is an old steady mare, with a little bell round her neck; and wheresoever she goes, the mules, like good children, follow her. If several large troops are turned into one field to graze, in the morning the muleteer has only to lead the madrinas a little apart, and tinkle their bells; and, although there may be two or three hundred mules together, each immediately knows its own bell, and separates itself from the rest. The affection of these animals for their madrinas saves infinite trouble. It is nearly impossible to lose an old mule; for if detained for several hours by force, she will, by the power of smell, like a dog, track out her companions, or rather the madrina; for, according to the muleteer, she is the chief object of affection. The feeling, however, is not of an individual nature; for I believe I am right in saying, that any animal with a bell will serve as madrina. In a troop each animal carries, on a level road, a cargo weighing 416 pounds (more than twenty-nine stone); but in a mountainous country a hundred pounds less.* Yet with what delicate slim limbs, without any proportional bulk of muscle, these animals support so great a burden! The

* Throughout Chile, except between Santiago and Valparaiso, every thing is conveyed on mules. This is an expensive method of transport, but unavoidable without good roads and improved waggons. In a troop of mules, there is generally a muleteer to each six animals.

mule always appears to me a most surprising animal. That a hybrid should possess more reason, memory, obstinacy, social affection, and powers of muscular endurance, than either of its parents, seems to indicate that art has here outmastered nature. Of our ten animals, six were intended for riding and four for carrying cargoes, each taking turn about. We carried a good deal of food, in case we should be snowed up, as the season was rather late for passing the Portillo.

March 19th.—We rode during this day to the last, and therefore most elevated house in the valley. The number of inhabitants became scanty; but wherever water could be brought on the land, it was very fertile. All the valleys in the Cordillera agree in the same kind of structure. An irregularly-stratified mass of well-rounded shingle, together with a little mud and sand, fills up the bottom to the depth of some hundred feet. This deposit follows the course of the valley, sloping upwards with a most gradual and gentle inclination. The rivers have removed a large part in the centre; thus leaving a terrace of equal height, but varying width, on each side. This narrow space between the cliffs bordering the bed of the river, and the foot of the mountains, is the only part fit for cultivation, and on it likewise the road is carried.

The rivers, such as the Maypo, which flow in these valleys, should rather be called mountain torrents. Their inclination is very great, and their water the colour of mud. The roar which the Maypo made, as it rushed over the great rounded fragments, was like that of the sea. Amidst the din of rushing waters, the noise from the stones, as they rattled one over another, was most distinctly audible even at a distance. This rattling noise, night and day, may be heard along the whole course of the torrent. The sound spoke eloquently to the geologist: the thousands and thousands of stones, which, striking against each other, make the one dull uniform sound, are all hurrying in one direction. It is like thinking of time, where the minute that

now glides past is irrecoverable. So is it with these stones; the ocean is their eternity, and each note of that wild music tells of one other step towards their destiny.

It is not possible for the mind to comprehend, except by a slow process, any effect which is produced by a cause repeated so often, that the multiplier itself ceases to convey any more definite idea, than the savage receives when he points to the hairs of his head. As often as I have seen beds of mud, sand, and shingle, accumulated to the thickness of many thousand feet, I have felt inclined to exclaim that causes, such as the present rivers and the present beaches, could never have ground down such masses. But, on the other hand, when listening to the rattling noise of these torrents, and calling to mind that whole races of animals have passed away from the surface of the globe, during the period throughout which, night and day, these stones have gone rattling onwards in their course, I have thought to myself, can any mountains, any continent, withstand such waste?

In this part of the valley, the mountains on each side are from about three to six or eight thousand feet high: their outline is rounded, but with steep and bare flanks. The general colour of the rock is a dullish purple, and the stratification very distinct. If the scenery is not beautiful, it is remarkable and grand. We met during the day several herds of cattle, which men were driving down from the higher valleys in the Cordillera. This sign of the approaching winter hurried our steps, more than was convenient for geological purposes. The house where we slept was situated at the foot of a mountain, on the summit of which are the mines of S. Pedro de Nolasko.

Sir F. Head wonders how mines have been discovered in situations so extraordinary, as the bleak summit of the mountain of S. Pedro de Nolasko. In the first place, metallic veins in this country are generally harder than the surrounding strata: hence, during the gradual degradation of the hills, they project above the

surface of the ground. Secondly, almost every labourer, especially in the northern parts of Chile, understands something about the appearance of ores. In the great mining provinces of Coquimbo and Copiapó, firewood is very scarce, and men are employed in searching for it over every hill and dale; and by this means nearly all the richest mines have there been discovered. Chanuncillo, from which silver, to the value of many hundred thousand pounds has been raised in the course of a few years, was thus discovered: a man having thrown a stone at his loaded donkey, afterwards thought that it was very heavy, and picking it up again, he found it was full of pure silver. The vein occurred at no great distance, standing up like a wedge of silver. The miners also, on Sundays, taking a crowbar with them, often set out on such discoveries. In the south part of Chile, the men who drive cattle into the Cordillera, and who frequent every ravine where there is a little pasture, are the usual agents.

March 20th.—As we ascended the valley, the vegetation, with the exception of a few pretty alpine flowers, became exceedingly scanty; and of birds, animals, or insects, scarcely one could be seen. The lofty mountains, their summits marked with a few patches of snow, stood well separated from each other; the valleys being filled up with an immense thickness of stratified alluvium. I may here briefly remark, without detailing the reasons on which the opinion is grounded, that in all probability this matter was accumulated at the bottoms of deep arms of the sea, which running from the inland basins, penetrated to the axis of the Cordillera,—in a similar manner to what now happens in the southern part of this same great range. This fact, in itself most curious, as preserving a record of a very ancient state of things, possesses a high theoretical interest, when considered in relation to the kind of elevation by which the present great altitude of these mountains has been attained.

The features in the scenery of the Andes which struck me most, as contrasted with the few other mountain chains with which I am acquainted, were,—the flat fringes sometimes expanding into narrow plains on each side the valleys,—the bright colours, chiefly red and purple, of the utterly bare and precipitous hills,—the grand and continuous wall-like dikes,—the strongly-marked strata which, when nearly vertical, form the most picturesque and wild pinnacles, but where less inclined, great massive mountains; the latter occupying the outskirts of the range, and the former the more lofty and central parts,—lastly, the smooth conical piles of fine and brightly-coloured detritus, which slope at a high angle from the flanks of the mountains to their bases, some of the piles having a height of more than two thousand feet.

I frequently observed both in Tierra del Fuego, and within the Andes, that where the rock was covered during the greater part of the year with snow, it was shivered in a very extraordinary manner into small angular fragments. Scoresby* has observed the same fact in Spitzbergen: he says, "The invariably broken state of the rocks appeared to have been the effect of frost. On calcareous rocks, some of which are not impervious to moisture, the effect is such as might have been expected; but how frost can operate in this way on quartz is not so easily understood." The whole phenomenon appears to me rather obscure: for that part of the mountain which is covered during many months by a mantle of snow, must be less subject to repeated and great changes of temperature than any other, yet it is the most affected. I have sometimes thought, that the earth and fragments of stone lying on the surface, were perhaps less effectually removed by means of slowly percolating snow-water,† than by the agency of rain, and therefore that the

* Scoresby's Arctic Regions, vol. i., p. 122.

† I have heard it remarked in Shropshire, that the water, when the Severn is flooded from long-continued rain, is much more turbid, than when it proceeds from the snow melting on the Welsh mountains. The

appearance of a quicker decay of the solid rock may be deceptive. Whatever the cause may be, the quantity of crumbling stone on the Cordillera is very great. Occasionally in the spring, masses of such matter slide down the mountains, and cover the snow-drifts in the valleys; thus forming natural ice-houses. We rode over one, the elevation of which was far below the limit of perpetual congelation.

As the evening drew to a close, we reached the Valle del Yeso. This is a very singular basin, which must have once been a very deep and large lake: the barrier is formed by a huge mountain of alluvium, on one side of which the river has cut a gorge. The plain is covered by a little dry pasture, and amidst the surrounding rocky deserts we had the pleasant sight of a herd of cattle. The valley takes its name of Yeso from a great bed, I should think at least two thousand feet thick, of white, and in some parts quite pure, gypsum. We slept with a party of men, who were employed in loading mules with this substance, which is used in the manufacture of wine.

March 21st.—We set out early in the morning, and continued to follow the course of the river, which by this time had become small, till we arrived at the foot of the ridge that separates the waters flowing into the Pacific and Atlantic oceans. The road, which as yet had been good, with a steady but very gradual ascent, now changed into a steep zigzag track. The Cordillera in this part consists of two principal ranges; the passes across which attain respectively an elevation of 13,210 and 14,365 feet.* The first great line (consisting of course of many subordinate ones) is called Peuquenes. It divides the waters, and there-

floods also, in the former case, are said to be more destructive to the land. D'Orbigny (vol. i., p. 184), in explaining the cause of the various colours of the rivers in South America, remarks that those with blue or clear water, have their source in the Cordillera, where the snow melts.

* Measurements made by Dr. Gillies; Edinburgh Journal of Nat. and Geograph. Science, August, 1830.

fore likewise the republics of Chile and Mendoza. To the eastward, a mountainous and elevated region separates it from the second range (called the Portillo) overlooking the Pampas. The streams from the intermediate tract find a passage a little way to the southward through this second line.

I will here give a very brief sketch of the geological structure of these mountains: first, of the Peuquenes, or western line; for the constitution of the two ranges is totally different. The lowest stratified rock is a dull red or purple claystone porphyry, of many varieties, alternating with conglomerates, and breccia composed of a similar substance: this formation attains a thickness of more than a mile. Above it there is a grand mass of gypsum, which alternates, passes into, and is replaced by, red sandstone, conglomerates, and black calcareous clay-slate. I hardly dare venture to guess the thickness of this second division; but I have already said some of the beds of gypsum alone attain a thickness of at least two thousand feet. Even at the very crest of the Peuquenes, at the height of 13,210 feet, and above it, the black clay-slate contained numerous marine remains, amongst which a gryphæa is the most abundant, likewise shells, resembling turritellæ, terebratulæ, and an ammonite. It is an old story, but not the less wonderful, to hear of shells, which formerly were crawling about at the bottom of the sea, being now elevated nearly fourteen thousand feet above its level. The formation probably is of the age of the central parts of the secondary series of Europe.

These great piles of strata have been penetrated, upheaved, and overturned, in the most extraordinary manner, by masses of injected rock, equalling mountains in size. On the bare sides of the hills, complicated dikes, and wedges of variously-coloured porphyries and other stones, are seen traversing the strata in every possible form and direction; proving also by their intersections, successive periods of violence. The rock which composes the axis of these great

lines of dislocation, at a distance very closely resembles granite, but on examination, it is found rarely to contain any quartz; and instead of ordinary felspar, albite.

The metamorphic action has been very great, as might have been expected from the close proximity of such grand masses of rock, which were injected when in a liquefied state from heat. When it is known, first, that the stratified porphyries have flowed as streams of submarine lava under an enormous pressure, and that the mechanical beds separating them owe their origin to explosions from the same submarine craters; secondly, that the whole mass in the lower part has generally been so completely fused into one solid rock by metamorphic action, that the lines of division can only be traced with much difficulty; and thirdly, that masses of porphyry, undistinguishable by their mineralogical characters from the two first kinds, have been subsequently injected;—the extreme complication of the whole will readily be believed.

We now come to the second range, which is of even greater altitude than the first. Its nucleus in the section seen in crossing the Portillo pass, consists of magnificent pinnacles of coarsely-crystallized red granite. On the eastern flank, a few patches of mica slate still adhere to the unstratified mass; and at the foot a stream of basaltic lava has burst forth at some remote period,—perhaps when the sea covered the wide surface of the Pampas. On the western side of the axis, between the two ranges, laminated fine sandstone has been penetrated by immense granitic dikes proceeding from the central mass, and has thus been converted into granular quartz rock. The sandstone is covered by other sedimentary deposits, and these again by a coarse conglomerate, the vast thickness of which I will not attempt even to estimate. All these coarse mechanical beds dip from the red granite directly towards the Peuquenes range, as if they passed beneath it; though such is not the case. On examining the pebbles composing this conglomerate (which, to my surprise, betrayed no signs of metamorphic

action), I was astonished to find perfectly rounded masses of the black calcareous clay-slate with organic remains,—the same rock which I had just crossed *in situ* on the Peuquenes. These phenomena compel us to arrive at the following conclusion:—that the Peuquenes existed as dry land for a long period anterior to the formation of the second range, and that, during this period, immense quantities of shingle were accumulated at its submarine flank. The action of a disturbing force then commenced: these more modern deposits were injected by dikes, altered by heat, and tilted towards the line whence, in the form of sediment and pebbles, they had originally proceeded,—thus making the offspring at first appear older than its parent. This second, grand, and subsequent line of elevation is parallel to the first and more ancient one.

I will only make one other geological observation: the Portillo chain in the neighbourhood of the pass is rather more elevated than the Peuquenes, yet the waters of the intermediate district have burst a passage through it. On the supposition of a subsequent and gradual elevation of the second line, this can be understood; for a chain of islets would at first appear, and as these were lifted up, the tides would always be working out deeper and broader channels between them. At the present day, even in the most retired sounds on the southern coast, the currents in the transverse breaks which connect the longitudinal channels, is so strong, that I have heard of one instance where a small vessel under sail was whirled round and round.

Mr. Pentland,* when describing an hydrographical phenomenon of a nearly similar kind, but on an infinitely grander scale, which occurs in Bolivia, says, "This very curious fact, of rivers escaping through such an immense mountain-mass as the Bolivian Cordillera, is perhaps one of the most important points connected with the physical geography of this portion of the Andes, and deserves to be

* Journal of the Royal Geograph. Society for 1835.

noticed at greater length." It would be extremely rash to affirm that the eastern chain in Bolivia, like that of central Chile, must be of subsequent origin to the western one, or that nearer to the Pacific: but excepting through the explanation above offered, the circumstance that rivers flowing from a less elevated chain, should penetrate one far more lofty, appears to me quite inexplicable.

About noon we began the tedious ascent of the Peuquenes, and then for the first time experienced some little difficulty in our respiration. The mules would halt every fifty yards, and then the poor willing animals after a few seconds started of their own accord again. The short breathing from the rarefied atmosphere is called by the Chilenos "puna;" and they have most ridiculous notions concerning its origin. Some say, "all the waters here have puna;" others that "where there is snow there is puna;"—and this no doubt is true. It is considered a kind of disease, and I was shown the crosses over the graves of some who had died "punado." Excepting perhaps in the case of a person suffering from some organic disease of the heart or chest, I should think this must be an erroneous conclusion. A person near death, would probably at this elevation experience a more unusual difficulty in breathing than others; and hence the effect might be assumed as the cause. The only sensation I felt was a slight tightness over the head and chest; a feeling which may be experienced by leaving a warm room and running violently on a frosty day. There was much fancy even in this; for upon finding fossil shells on the highest ridge, I entirely forgot the puna in my delight. Certainly the exertion of walking was extreme, and the respiration became deep and laborious. It is incomprehensible to me, how Humboldt and others were able to ascend to the elevation of 19,000 feet. No doubt a residence of some months in the lofty region of Quito would prepare the constitution for such an exertion; yet I am told that in Potosi (about 13,000 feet), strangers do not become quite accustomed to the atmosphere for an entire year. The inhabitants all recommend onions

for the puna; as this vegetable has sometimes been given in Europe for pectoral complaints, it may possibly be of real service:—for my part, I found nothing so good as the fossil shells!

When about halfway up we met a large party with seventy loaded mules. It was interesting to hear the wild cries of the muleteers, and to watch the long string descending; they appeared so diminutive, there being nothing but the bleak mountains with which they could be compared. When near the summit, the wind, as generally happens there, was impetuous and extremely cold. On each side of the ridge we had to pass over broad bands of snow, which perpetually lie there, and were now soon to be covered by a fresh layer. When we reached the crest and looked backwards, a glorious view was presented. The atmosphere resplendently clear; the sky an intense blue; the profound valleys; the wild broken forms; the heaps of ruins, piled up during the lapse of ages; the bright-coloured rocks, contrasted with the quiet mountains of snow; all these together produced a scene I never could have figured to my imagination. Neither plant nor bird, excepting a few condors wheeling around the higher pinnacles, distracted the attention from the inanimate mass. I felt glad I was alone: it was like watching a thunderstorm, or hearing a chorus of the Messiah in full orchestra.

On several of the patches of perpetual snow, I found the *Protococcus nivalis*, or red snow, so well known from the accounts of Arctic navigators. My attention was called to the circumstance by observing the footseps of the mules stained a pale red, as if their hoofs had been slightly bloody. I at first thought it was owing to dust blown from the surrounding mountains of red porphyry; for from the magnifying power of the crystals of snow, the groups of these atom-like plants appeared like coarse particles. The snow was coloured only where it had thawed very rapidly, or had been accidentally crushed. A small portion of it rubbed on paper communicated a faint rose tinge, mingled with a little brick red. I placed some of the snow between the leaves of

my pocket-book, and a month afterwards examined with care the pale discoloured patches on the paper. The specimens, when scraped off, were of a spherical form, with a diameter of the thousandth of an inch. The central part consists of a blood-red substance, surrounded by a colourless bark. When living on the snow they are collected in groups, many lying close together; I overlooked, however, the thin couch of gelatinous matter on which they are said to rest.* The dried specimens placed in any fluid, as water, spirits of wine, or dilated sulphuric acid, were acted on in two different ways: sometimes an expansion was caused, at others a contraction. The central part after immersion invariably appeared as a drop of red oily fluid, containing a few most minute granules; and these probably are the germs of new individuals.

As I before remarked, the wind on the crest of the Peuquenes is generally impetuous and very cold. It is said to blow steadily from the westward or Pacific side: a circumstance which is likewise mentioned by Dr. Gillies.† As these observations apply chiefly to the summer season (when the passes are frequented), we must consider this wind, as an upper and return current. The Peak of Teneriffe, with a less elevation, and situated in lat. 28°, in like manner falls within the return stream. At first it appears rather surprising, that the trade-wind along the northern parts of Chile, and on the coast of Peru, should blow in so very southerly a direction as it does; but when we reflect, that the Cordillera, running in a north and south line, intercepts, like a great wall, the entire depth of the lower atmospheric current, we can easily see, that the trade-wind must be drawn northward, following the line of mountains, towards the equatorial regions, and thus lose part of that easterly movement which it otherwise would have gained from the rotation of the world. At Mendoza, on the eastern foot of the Andes, the climate is said to be subject to long calms, and to frequent

* Greville's Scottish Cryptogam. Flora, vol. iv., p. 231.

† Journal of Natural and Geographical Science, August, 1830.

though false appearances of gathering rain-storms: we may imagine that the wind, which coming from the eastward is thus banked up by the line of mountains, would become stagnant and irregular in its movements.

Having crossed the Peuquenes, we descended into the mountainous country, intermediate between the two ranges, and then took up our quarters for the night. The elevation was probably not much under 11,000 feet, and the vegetation in consequence exceedingly scanty. The root of a small scrubby plant served as fuel, but it made a miserable fire, and the wind was piercingly cold. Being quite tired with my day's work, I made up my bed as quickly as I could, and went to sleep. About midnight I observed the sky became suddenly clouded: I awakened the arriero to know if there was any danger of bad weather; but he said that without thunder and lightning there was no risk of a heavy snow-storm. The peril is imminent, and the difficulty of subsequent escape great, to any one overtaken by bad weather between the two Cordillera. A certain cave offers the only place of refuge: Mr. Caldcleugh, who crossed on this same day of the month, was detained there for some time by a heavy fall of snow, as is related in his travels. Casuchas, or houses of refuge, have not been built in this pass as in that of Uspallata, and therefore, during the autumn, the Portillo is little frequented. I may here remark, that within the main Cordillera rain never falls, for during the summer, the sky is cloudless, and in winter snow-storms alone occur.

At the place where we slept, water necessarily boiled, from the diminished pressure of the atmosphere, at a much lower temperature than it does in a less elevated country; the case being the converse of that of a Papin's digester. In consequence of this, the potatoes, after remaining for some hours in the boiling water, were nearly as hard as ever. The pot was left on the fire all night, and next morning it was boiled again, but yet the potatoes were not cooked. I found out this, by overhearing my two companions discussing the cause; they had come to the simple conclusion, " that the

cursed pot (which was a new one) did not choose to boil potatoes."

March 22d.—After eating our potato-less breakfast, we travelled across the intermediate tract, to the foot of the Portillo range. In the middle of summer cattle are brought up here to graze; but they had now all been removed; even the greater number of the guanacoes had decamped, knowing well, that, if overtaken by a snow-storm, they would be caught in a trap. We had a fine view of a mass of mountains called Tupungato, the whole clothed with unbroken snow. From one peak my arriero said he had once seen smoke proceeding; and I thought I could distinguish the form of a large crater. In the maps Tupungato figures as a single mountain; this Chileno method of giving one name to a tract of mountains is a fruitful source of error. In the region of snow there was a blue patch, which no doubt was a glacier;—a phenomenon that has been said not to occur in these mountains.

Now commenced a heavy and long climb, similar to that up the Peuquenes. Bold conical hills of red granite rose on each hand; and in the valley there were several broad fields of perpetual snow. These frozen masses, during the process of thawing, had in some parts assumed the form of pinnacles or columns, which, as they were high and close together, caused some difficulty on account of the cargo mules. This structure in frozen snow was long since observed by Scoresby in the icebergs near Spitzbergen, and lately, with more care, by Colonel Jackson* on the Neva. On one of these columns of ice a frozen horse was exposed, sticking as on a pedestal, but with its hind legs straight up in the air. To account for its strange position, we must

* Journal of Geograph. Soc., vol. v., p. 12. Mr. Lyell (vol. iv., p. 360) has compared the fissures, by which the columnar structure seems to be determined, to the joints that traverse nearly all rocks, but which are best seen in the non-stratified masses. I may observe, in the case of the frozen snow, the columnar structure must be owing to a "metamorphic" action and not to a process during *deposition*.

suppose that the animal fell with its head downward into a hole, when the stratum was continuous, and that afterwards the surrounding parts were removed by the thaw.

When nearly on the crest of the Portillo, we were enveloped in a cloud which was falling, under the form of minute frozen spicula. This was very unfortunate, as it continued the whole day, and quite intercepted our view. The pass takes its name of Portillo from a narrow cleft or doorway on the highest ridge, through which the road passes. From this point, on a clear day, those vast plains which extend from the base of the mountains towards the Atlantic can be seen. We descended to the upper limit of vegetation, and found good quarters for the night under the shelter of some large fragments of rock. We here met some passengers, who made anxious inquiries about the state of the road. Shortly after it was dark, the clouds suddenly cleared away; and the effect was quite magical. The great mountains, bright with the full moon, seemed impending over us on all sides, as if we had been buried at the bottom of some deep crevice. One morning also, very early, I witnessed the same striking effect. As soon as the clouds were dispersed, it froze severely; but as there was no wind, we slept very comfortably.

The increased brilliancy of the moon and stars at this elevation, owing to the perfect transparency of the atmosphere, was very remarkable. Travellers having observed the difficulty of judging heights and distances amidst lofty mountains, have generally attributed it to the absence of objects of comparison. It appears to me that it is fully as much owing to this transparency, confounding different distances, and partly, likewise, to the novelty of an unusual degree of fatigue arising from a little exertion,—habit being thus opposed to the evidence of the senses. I am sure that this extreme clearness of the air gives a peculiar character to the landscape; all objects appearing to be brought nearly into one plane, as in a drawing or panorama. The transparency is, I presume, owing to the equable and nearly perfect

state of atmospheric dryness. The latter quality was shown by the manner in which woodwork shrunk (as I soon found by the trouble my geological hammer gave me); by articles of food, such as bread and sugar, becoming extremely hard; and by the preservation of the skin and parts of the flesh of the beasts, which perish on the road. To the same cause we must attribute the singular facility with which electricity is excited. My flannel-waistcoat, when rubbed in the dark, appeared as if it had been washed with phosphorus;—every hair on a dog's back crackled;—even the linen sheets, and leathern straps of the saddle, when handled, emitted sparks.

March 23d.—The descent on the eastern side of the Cordillera is much shorter or steeper than on the Pacific side; in other words, the mountains rise more abruptly from the plains, than from the alpine country of Chile. A level and brilliantly white sea of clouds was extended beneath our feet, and thus shut out the view of the equally level Pampas. We soon entered the band of clouds, and did not again emerge from it that day. About noon, finding pasture for the animals and bushes for firewood, in a part of the valley called Los Arenales, we stopped for the night. This was near the uppermost limit of bushes, and the elevation, I suppose, was between seven and eight thousand feet.

I was very much struck with the marked difference between the vegetation of these eastern valleys and that of the opposite side: yet the climate, as well as the kind of soil, is nearly identical, and the difference of longitude very trifling. The same remark holds good with the quadrupeds, and in a lesser degree with the birds and insects. We must except certain species which habitually or occasionally frequent elevated mountains; and in the case of the birds, certain kinds, which have a range as far south as the Strait of Magellan. This fact is in perfect accordance with the geological history of the Andes; for these mountains have existed as a great barrier, since a period so remote that whole races of animals must subsequently have perished from the face of the earth. Therefore, unless we suppose the same species to have been

created in two different countries, we ought not to expect any closer similarity between the organic beings on opposite sides of the Andes, than on shores separated by a broad strait of the sea. In both cases we must leave out of the question those kinds which have been able to cross the barrier, whether of salt water or solid rock.*

A great number of the plants and animals were absolutely the same, or most closely allied with those of Patagonia. We here have the agouti, bizcacha, three species of armadillo, the ostrich, certain kinds of partridges, and other birds, none of which are ever seen in Chile, but are the characteristic animals of the desert plains of Patagonia. We have likewise many of the same (to the eyes of a person who is not a botanist) thorny stunted bushes, withered grass, and dwarf plants. Even the black slowly-crawling beetles are closely similar, and some, I believe, on rigorous examination, absolutely identical. It had always been a subject of regret to me, that we were unavoidably compelled to give up the ascent of the St. Cruz river before reaching the mountains. I always had a latent hope of meeting with some great change in the features of the country; but I now feel sure, that it would only have been following the plains of Patagonia up an ascent.

March 24th.—Early in the morning I climbed up a mountain on one side of the valley, and enjoyed a far-extended view over the Pampas. This was a spectacle to which I had always looked forward with interest, but I was disappointed. At the first glance there was a strong resemblance to a distant view of the ocean, but in the northern parts many irregularities in the surface were soon distinguishable. The most striking feature in the scene consisted of the rivers,

* This is merely an illustration of the admirable laws first laid down by Mr. Lyell of the geographical distribution of animals as influenced by geological changes. The whole reasoning, of course, is founded on the assumption of the immutability of species. Otherwise the changes might be considered as superinduced by different circumstances in the two regions during a length of time.

which, facing the rising sun, glittered like silver threads, till lost in the immensity of the distance.

In the middle of the day, we descended the valley, and reached a hovel, where an officer and three soldiers were posted to examine passports. One of these men was a thorough-bred Pampas Indian. He was kept much for the same purpose as a bloodhound, to track out any person who might pass by secretly, either on foot or horseback. Some years ago, a passenger had endeavoured to escape detection, by making a long circuit over a neighbouring mountain; but this Indian, having by chance crossed his track, followed it for the whole day, over dry and very stony parts, till at last he came on his prey hidden in a gully. We here heard that the silvery clouds, which we had admired from the bright region above, had poured down torrents of rain. The valley from this point gradually opened, and the hills became mere water-worn hillocks compared to the giants behind. It then expanded into a gently-sloping plain of shingle, covered with low trees and bushes. This talus, although it looked of little breadth, must be nearly ten miles wide, before it blends into the apparently dead level Pampas. We had already passed the only house in this neigbourhood, the Estancia of Chaquaio; and at sunset we pulled up in the first snug corner, and there bivouacked.

March 25th.—I was reminded of the Pampas of Buenos Ayres, by seeing the disk of the rising sun, intersected by an horizon, level as that of the ocean. During the night a heavy dew had fallen, a fact we did not experience within the Cordillera. The road proceeded for some distance due east across a low swamp; then meeting the dry plain, it turned to the north towards Mendoza. The distance is two very long days' journey. Our first day's journey was called fourteen leagues to Estacado, and the second seventeen to Luxan, near Mendoza. The whole distance is over a level desert plain, with not more than two or three houses. The sun was exceedingly powerful, and the ride devoid of all interest. There is very little water in this "traversia," and in our

second day's journey, we found only one little pool. The water flowing from the mountains is small in quantity and soon becomes absorbed by the dry and porous soil; so that, although we travelled at the distance of only ten or fifteen miles from the outer range, we did not cross a single stream. In many parts the ground was incrusted with a saline efflorescence; hence we had the same salt-loving plants, common near Bahia Blanca. The landscape has one character from the Strait of Magellan along the whole eastern coast of Patagonia to the Rio Colorado; and it appears that the same kind of country extends northerly in a sweeping line as far as San Luis, and perhaps even further. To the eastward of this line, lies the basin of the comparatively damp and green plains of Buenos Ayres. The former country, including the sterile traversia of Mendoza and Patagonia, consists of a bed of shingle, worn smooth, and accumulated by the waves of a former sea; while the formation of the Pampas (plains covered by thistles, clover, and grass) is due to the estuary mud of the Plata, deposited under a different condition of circumstances.

After our two days' tedious journey, it was refreshing to see in the distance the rows of poplars and willows growing around the village and river of Luxan. Shortly before we arrived at this place, we observed to the southward a ragged cloud of a dark reddish-brown colour. For some time, we had no doubt but that it was thick smoke proceeding from some great fire on the plains. Soon afterwards we found it was a pest of locusts.* The insects overtook us, as they were travelling northward, by the aid of a light breeze, at the rate, I should suppose, of ten or fifteen miles an hour. The main body filled the air from a height of twenty feet, to that, as it appeared, of two or three thousand above the ground. The noise of their approach was that of a strong breeze† pass-

* The species is identical with, or resembles most closely, the famous *Gryllus migratorius* of eastern countries.

† "And the sound of their wings was as the sound of chariots of many horses running to battle."—*Revelat.* ix. 9.

ing through the rigging of a ship. The sky seen through the advanced guard appeared like a mezzotinto engraving, but the main body was impervious to sight; they were not, however, so thick, but that they could escape from a stick moved backward and forward. When they alighted they were more numerous than the leaves in a field, and changed the green into a reddish colour: the swarm having once alighted, the individuals flew from side to side in any direction. The locusts are not an uncommon pest in this country: already during the season, several smaller swarms had come up from the sterile plains* of the south; and many trees had been entirely stripped of their leaves. Of course this swarm cannot even be compared to those of the eastern world, yet it was sufficient to make the well-known descriptions of their ravages more intelligible. I have omitted, perhaps, the most striking part of the scene,—the vain attempts of the poor cottagers to turn the stream aside. Many lighted fires and with the smoke, with shouts and waving of branches, they endeavoured to avert the attack.

We crossed the Luxan, which is a river of considerable size, though its course towards the sea-coast is very imperfectly known. It is even doubtful whether, in passing over the plains, it is evaporated, or whether it forms a tributary of the Sauce or Colorado. We slept in the village, which is a small place surrounded by gardens, and forms the most southern part, that is cultivated, of the province of Mendoza; it is five leagues south of the capital. At night I experienced an attack (for it deserves no less a name) of the *Benchuca* (a species of Reduvius) the great black bug of the Pampas. It is most disgusting to feel soft wingless insects, about an inch long, crawling over one's body. Before sucking they are quite thin, but afterwards become round and bloated with blood, and in this state they are easily crushed.

* Swarms of locusts sometimes overrun the more central plains of this continent. In these cases, and likewise as it appears in all parts of the world, the locusts are bred in desert plains, and thence migrate towards a more fertile country.

They are also found in the northern parts of Chile and in Peru. One which I caught at Iquique was very empty. When placed on the table, and though surrounded by people, if a finger was presented, the bold insect would immediately draw its sucker, make a charge, and if allowed, draw blood. No pain was caused by the wound. It was curious to watch its body during the act of sucking, as it changed in less than ten minutes, from being as flat as a wafer to a globular form. This one feast, for which the benchuca was indebted to one of the officers, kept it fat during four whole months; but, after the first fortnight, the insect was quite ready to have another suck.

March 27th.—We rode on to Mendoza. The country was beautifully cultivated, and resembled Chile. This neighbourhood is celebrated for its fruit; and certainly nothing could appear more flourishing than the vineyards and the orchards of figs, peaches, and olives. We bought water-melons nearly twice as large as a man's head, most deliciously cool and well-flavoured, for a halfpenny apiece; and for the value of threepence, half a wheelbarrowful of peaches. The cultivated and enclosed part of this province is very small; there is little more than that which we passed through between Luxan and the capital. The land, as in Chile, entirely owes its fertility to artificial irrigation; and it is really wonderful to observe how abundantly productive a barren traversia is rendered by this simple process.

We staid the ensuing day in Mendoza. The prosperity of the place has much declined of late years. The inhabitants say "it is good to live in, but very bad to grow rich in." The lower orders have the lounging, reckless manners of the Gauchos of the Pampas; and their dress, riding-gear, and habits of life, are nearly the same. To my mind the town had a stupid forlorn aspect. Neither the boasted alameda, nor the scenery, is at all comparable to that of Santiago; but to those who have just crossed the unvaried savannahs of grass, on their road from Buenos Ayres, the gardens and orchards must appear delightful. Captain Head, speaking of

the inhabitants, says, "They eat their dinners, and it is so very hot, they go to sleep—and could they do better?" I quite agree with Captain Head: the happy doom of the Mendozinos is to eat, sleep, and be idle.

March 29th.—We set out on our return to Chile by the Uspallata pass to the northward of Mendoza. We had to cross a long and most sterile traversia of fifteen leagues. The soil in parts was absolutely bare, in others covered by numberless dwarf cacti, armed with formidable spines, and called by the inhabitants "little lions." There were also a few low bushes. Although the plain is elevated about three thousand feet above the sea, the sun was very powerful; this, and the clouds of impalpable dust, rendered the travelling extremely irksome. Our course during the day lay nearly parallel to the mountains, but gradually approaching them. Before sunset we entered one of the wide valleys, or rather bays, which open on the plain: this soon narrowed into a ravine, and a little higher up the house of the Villa Vicencio was situated. As we had ridden all day without a drop of water, both ourselves and our animals were very thirsty, and we looked out anxiously for the stream which flows down this valley. It was curious to observe how gradually the water made its appearance: on the plain the course was quite dry; by degrees it became a little damper; then puddles of water were formed; these soon became connected, and at Villa Vicencio there was a nice little rivulet.

30th.—The solitary hovel which bears the imposing name of Villa Vicencio, has been mentioned by every traveller who has crossed the Andes. I staid here, and at some neighbouring mines, during the two succeeding days. The geology of the surrounding country is very curious. The Uspallata range is separated from the true Cordillera by a long narrow plain or basin, like those so often mentioned in Chile, but with an altitude of about six thousand feet. The range consists of various kinds of submarine lava, alternating with volcanic sandstones and other remarkable sedimentary deposits; the whole having a very close resemblance to some of

the newer horizontal beds on the shores of the Pacific. From this resemblance I expected to find silicified wood, which is generally characteristic of those formations. I was gratified in a very extraordinary manner. In the central part of the range, at an elevation probably of seven thousand feet, on a bare slope, I observed some snow-white projecting columns. These were petrified trees, eleven being silicified, and from thirty to forty converted into coarsely-crystallized white calcareous spar. They were abruptly broken off; the upright stumps projecting a few feet above the ground. The trunks measured from three to five feet each in circumference. They stood a little way apart from each other, but the whole formed one distinct group. Mr. Robert Brown has been kind enough to examine the wood: he says it is coniferous, and that it partakes of the character of the Araucarian tribe (to which the common South Chilian pine belongs), but with some curious points of affinity with the yew. The volcanic sandstone in which they were embedded, and from the lower part of which they must have sprung, had accumulated in successive thin layers around their trunks; and the stone yet retained the impression of the bark.

It required little geological practice to interpret the marvellous story, which this scene at once unfolded; though I confess I was at first so much astonished that I could scarcely believe the plainest evidence of it. I saw the spot where a cluster of fine trees had once waved their branches on the shores of the Atlantic, when that ocean (now driven back 700 miles) approached the base of the Andes. I saw that they had sprung from a volcanic soil which had been raised above the level of the sea, and that this dry land, with its upright trees, had subsequently been let down to the depths of the ocean. There it was covered by sedimentary matter, and this again by enormous streams of submarine lava—one such mass alone attaining the thickness of a thousand feet; and these deluges of melted stone and aqueous deposits had been five times spread out alternately. The ocean which received such masses must have been deep; but again the subterra-

nean forces exerted their power, and I now beheld the bed of that sea forming a chain of mountains more than seven thousand feet in altitude. Nor had those antagonist forces been dormant, which are always at work to wear down the surface of the land to one level: the great piles of strata had been intersected by many wide valleys; and the trees now changed into silex were exposed projecting from the volcanic soil now changed into rock, whence formerly in a green and budding state they had raised their lofty heads. Now, all is utterly irreclaimable and desert; even the lichen cannot adhere to the stony casts of former trees. Vast, and scarcely comprehensible as such changes must ever appear, yet they have all occurred within a period recent when compared with the history of the Cordillera; and that Cordillera itself is modern as compared with some other of the fossiliferous strata of South America.

April 1st.—We crossed the Uspallata range; and at night slept at the custom-house—the only inhabited spot on the plain. Shortly before leaving the mountains, there was a very extraordinary view: red, purple, green, and quite white sedimentary rocks, alternating with black lavas, were broken up and thrown into all kinds of disorder, by masses of porphyry, of every shade, from dark brown to the brightest lilac. It was the first view I ever saw, which really resembled those pretty sections which geologists make of the inside of the earth.

The next day we crossed the plain, and followed the course of the same great mountain-stream which flows by Luxan. Here it was a furious torrent, quite impassable, and appearing larger than in the low country; as was the case with the rivulet of Villa Vincencio. On the evening of the succeeding day we reached the Rio de las Vacas, which is considered the worst stream in the Cordillera to cross. As all these rivers have a rapid and short course, and are due to the snow melted by the sun's heat, the hour of the day makes a considerable difference in their volume. In the evening the stream is muddy and full, but about daybreak it becomes both clearer and much less impetuous.

This we found to be the case with the Rio Vacas, and in the morning we crossed it with little difficulty.

The scenery thus far was very uninteresting, compared with that of the Portillo pass. Little can be seen beyond the bare walls of the one grand, flat-bottomed valley, which the road follows up to the highest crest. The valley and the huge rocky mountains were extremely barren: during the two previous nights the poor mules had absolutely nothing to eat; for excepting a few low resinous bushes, scarcely a plant could be seen. We went over in the course of this day some of the worst passes in the Cordillera. The degree of exaggeration concerning their danger and difficulty is very great. In Chile I was even told, that if I attempted to pass on foot my head would turn giddy, that there was no room to dismount, &c., but I did not see a place where any one might not have walked over backwards, or got off his mule on either side. One of the bad passes called *las Animas* (the Souls), I had crossed, and did not find out till a day afterwards that it was one of the awful dangers. No doubt there are many parts in which, if the mule should stumble, the rider would be hurled down a great precipice; but of such a catastrophe there is much less chance than with a man on foot. I dare say, in the spring, the "laderas," or roads, which each year are formed anew across the piles of fallen detritus, are very bad; but from what I have seen, I suspect the real danger is nothing, and the apparent very little. With cargo mules the case is rather different; for the loads project so far, that the animals occasionally running against each other, or against a point of rock, lose their balance and are thrown down the precipice. With regard to crossing the rivers, I can well believe that the difficulty amounts to every degree, till they are impracticable. At this season there was little trouble, but in the summer they must be very bad. I can quite imagine, as Captain Head describes, the different expressions of those who *have* passed the gulf, and those who *are* passing. I never heard of any man being drowned, but with loaded mules this is of frequent

occurrence. The arriero tells you to show your mule the best line, and then allow her to cross as she chooses; the cargo mule takes a bad line, and is often lost.

April 4th.—From the Rio de las Vacas to the Puente del Inca, half a day's journey. As there was pasture for the mules, and geology for me, we bivouacked for the night. When one hears of a natural bridge, one pictures to oneself some deep and narrow ravine, across which a bold mass of rock has fallen; or a great arch hollowed out like the vault of a cavern. Instead of this, the Inca's bridge consists of a crust of stratified shingle, cemented together by the deposits of the neighbouring hot springs. It appears as if the stream had scooped out a channel on one side, leaving an overhanging ledge, which was at last met by the earth and stones falling down from the opposite cliff. Certainly an oblique junction, as would happen in such case, was very distinct on one side. The bridge of the Incas is by no means worthy of the great monarchs whose name it bears.

Close by, there were some ruins of Indian buildings. These occur in several other places; the most perfect, which I saw, being the Ruinas de Tambillos. Small square rooms were there huddled together, but placed in distinct groups. Some of the doorways were yet standing: they were formed by a cross slab of stone, but only raised about three feet high. Ulloa, in his "Noticias Americanas," remarks on the lowness of the doors in the ancient Peruvian dwellings. These houses, when perfect, must have been capable of containing a considerable number of persons. Tradition says, they were used as halting-places for the Incas, when they crossed these mountains. Traces of Indian habitations have been discovered in many parts of the Cordillera, where it does not appear probable, that they were constructed as mere resting-places; but yet where the land is as utterly unfit for any kind of cultivation as it is near the Tambillos or Puente del Inca. In the Portillo pass I saw one group of such ruins. In the ravine of Jajuel, near Aconcagua, where there is no pass, I heard of numerous remains situated

at a great elevation, where it is both cold and extremely sterile. At first I imagined, that these houses were places of refuge built by the Indians on the first arrival of the Spaniards; but subsequently I have been almost inclined to speculate on the possibility of a small change of climate.

In the northern parts of Chile, within the Cordillera of Copiapó, old Indian houses are found in very many parts: by digging amongst the ruins, bits of woollen articles, instruments of precious metals, and heads of Indian corn, are not unfrequently discovered. I had likewise in my possession the head of an arrow, made of agate, of precisely the same figure as those now used in Tierra del Fuego. I am aware that the Peruvian Indians* frequently inhabit most lofty and bleak situations; but in these cases, I was assured by men, who had spent their lives in travelling the Andes, that very many (*muchisimas*) houses were found at elevations so great as almost to border on the perpetual snow, and in parts where there exist no passes, and where the land produces absolutely nothing, and what is still more extraordinary, where there is no water. Nevertheless it is the opinion of the people of the country (although they are much puzzled by the circumstance), that, from the appearance of the houses, the Indians must have used them as places of residence. In the Despoblado (uninhabited valley), near Copiapó, at a spot called Punta Gorda, I saw the remains of seven or eight square little rooms, which were of a similar form with those at the Tambillos, but built chiefly of mud (which the present inhabitants cannot by any means imitate in durability†) instead of with stone. They were situated in the most conspicuous and defenceless position,

* Mr. Pentland even considers, that the love of an elevated situation is characteristic of the constitution of this race.—*Geograph. Journ.*

† Ulloa (Noticias Americanas, p. 302) remarks on the same circumstance in Peru. He adds, when speaking of the mud bricks, "which gives room to think that they had some particular method of working them, that they should become hard, without cracking, the secret of which the present inhabitants are ignorant of."

at the bottom of a flat broad valley. There was no water nearer than three or four leagues, and that only in very small quantity, and bad: the soil was absolutely sterile;—I looked in vain even for a lichen adhering to the rocks. At the present day, with the advantage of beasts of burden, a mine, unless it were very rich, could scarcely be worked there with profit. Yet the Indians formerly chose it as a place of residence! If at the present time two or three showers of rain were to fall annually, instead of one during as many years, as now is the case, a small rill of water would in all probability be formed in this great valley, draining a mountainous country; and then, by irrigation (the method of which was formerly so well understood by the Indians), the soil might easily be rendered sufficiently productive to support a few families.

I have certain proofs that this part of the continent of South America has been elevated, near the coast, at least from four to five hundred feet, since the epoch of existing shells; and further inland the rise possibly may have been greater. As the peculiarly arid character of the climate is evidently a consequence of the height of the great range of mountains, we may feel almost sure, that prior to the latter elevations, the atmosphere was not so completely drained of its moisture as at the present day. At a remote geological era, it is probable that the Andes consisted of a chain of islands, which were covered by luxuriant forests; and many of the trees, in a silicified state, may now be seen embedded in the upper conglomerates. Of these I measured one which was cylindrical, with a circumference of fifteen feet. As it is nearly certain that the mountains have risen slowly, so would the climate likewise become deteriorated slowly. We need not feel greatly surprised at walls of stone and hardened mud here lasting for many ages, when we remember how many centuries the Druidical mounds have withstood even the climate of England. The only question is, whether the amount of change, since the introduction of man into South America, has been sufficient to cause a sensible

effect on the atmospheric moisture, and therefore on the fertility of the valleys in the upper Cordillera. From the extreme slowness with which there is reason to believe the continent is rising, the longevity of man as a species, required to allow of sufficient change, is the most valid objection to the above speculations: for on the eastern shores of this continent, we have seen that several animals, belonging to the same class of mammalia with man, have passed away, while the change of level between land and water, in that part at least, has been so small, that it can scarcely have caused any sensible difference in the climate. I may add, however, that at Lima, the elevation, within the human epoch, certainly has amounted to between seventy and eighty feet.

When at Lima, I conversed on this subject* with Mr. Gill, a civil engineer, who had seen much of the interior country. He told me that a conjecture of a change of climate had sometimes crossed his mind; but that he thought that the greater portion of land now incapable of cultivation, but covered with Indian ruins, had been reduced to that condition, by neglect and subterranean movements injuring the water conduits, which the Indians formerly constructed on so wonderful a scale. I may here just mention that these people actually carried tunnels through hills of solid rock, when such were necessary to conduct the irrigating streams. Mr. Gill told me, he had been employed professionally to examine one; he found the passage low, narrow, crooked, and not of uniform breadth, but of very considerable length. Is it not most wonderful that any people should have attempted such operations without the aid of iron or of gunpowder!

* Temple, in his travels through upper Peru or Bolivia, in going from Potosi to Oruro, says, "I saw many Indian villages or dwellings in ruins, up even to the very tops of the mountains, attesting a former population where now all is desolate." He makes similar remarks in another place, but it is not possible to judge, whether this desolation is owing merely to a want of population, or to an altered condition of the land.

Mr. Gill mentioned to me a most interesting, and as far as I am aware, quite unparalleled case, of the effect of subterranean disturbances in altering the drainage of a country. Travelling from Casma to Huaraz (not very far distant from Lima), he found a plain covered with ruins and marks of ancient cultivation, but now quite barren. Near it was the dry course of a considerable river, whence the water for irrigation had formerly been conducted. There was nothing in the appearance of the watercourse to indicate that the river had not flowed there a few years previously: in some parts beds of sand and gravel were scattered, and in others the solid rock had been worn into a broad channel.* It is self-evident that a person following up the course of a stream, will always ascend at a greater or less inclination. Mr. Gill was therefore very much astonished, when walking up the bed of this ancient river, to find himself suddenly going down hill. He imagined that the slope had a fall of about forty or fifty feet perpendicular. We here have the most unequivocal evidence, that a ridge or line of hills has been uplifted directly across the bed of a stream, which must have been flowing for many centuries. From the moment the river-course was thus arched, the water would necessarily be thrown back; and a new channel would be formed on one side some way above. From that time, also, the neighbouring plain would lose its fertilizing stream, and become converted into the desert which it now remains.

April 5th.—We had a long day's ride across the central ridge, from the Inca's bridge to the Ojos del Agua, which is situated near the lowest *casucha* on the western slope. These casuchas are little round towers, with steps outside to reach the floor, which is elevated some feet above the ground on account of the snow-drifts. They are eight in number; and under the Spanish government, were kept

* Mr. Gill said he recollected that one part, which had been cut out of the solid rock, was about forty yards wide and eight feet deep. This is sufficient to give some idea of the size of the former stream.

during the winter well stored with food and charcoal, and each courier had a master-key. Now they only answer the purpose of caves, or rather dungeons. Seated on some little eminence, they are not, however, ill suited to the surrounding scene of desolation. The zigzag ascent of the Cumbre, or the partition of the waters, was very steep and tedious. The height, according to Mr. Pentland,* is 12,454 feet. The road did not pass over any perpetual snow, although there were patches on either hand. The wind on the summit was exceedingly cold, but it was impossible not to stop a few minutes to admire, again and again, the colour of the heavens, and the brilliant transparency of the atmosphere. The scenery, moreover, was grand. To the westward there was a fine chaos of mountains, divided by profound ravines. Generally some snow has fallen before this period of the season, and it has even happened that the Cordillera has been finally closed by this time. But we were most fortunate. The sky, by night and by day, was cloudless, excepting perhaps a few round little masses of vapour, that floated over the highest pinnacles. I have often seen these islets in the sky, marking the position of the Cordillera, when the mountains themselves have been hidden beneath the horizon.

April 6th.—In the morning we found some thief had stolen one of our mules, and the bell of the madrina. We therefore rode only two or three miles down the valley, and staid there the ensuing day in hopes of recovering the mule, which the arriero thought had been hidden in some ravine. The scenery in this part had assumed a Chilian character: the lower parts of the mountains, dotted over with the pale evergreen Quillay tree, and with the great candlestick cactus, certainly are more to be admired than any thing in the bare Eastern valleys; but I cannot quite agree with the admiration expressed by some travellers. The extreme pleasure, I suspect, is chiefly owing to the prospect of a good fire,

* Geographical Journal. Notice on Bolivian Cordillera, March, 1835.

after escaping from the cold regions above: and I am sure I most heartily participated in such feelings.

8TH.—We left the valley of the river of Aconcagua, by which we had descended, and reached in the evening a cottage near the Villa de St. Rosa. The fertility of the plain was extremely delightful. The autumn being well advanced, the leaves of many of the fruit-trees were falling; and of the labourers—some were busy in drying figs and peaches on the roofs of their cottages; while others were gathering the grapes from the vineyards. It was a pretty scene; but that pensive stillness was absent, which makes the autumn in England indeed the evening of the year.

On the 10th we reached Santiago, where I experienced a very kind and hospitable reception from Mr. Caldcleugh. My excursion only cost me twenty-four days, and never did I more deeply enjoy an equal space of time. A few days afterwards I returned to Mr. Corfield's house at Valparaiso.

CHAPTER XVIII.

Bell mountain—Miners—Great loads carried by the Apires—Coquimbo—Earthquake—Geology—Terraces—Excursion up valley—Road to Guasco—Desert country—Valley of Copiapó—Rain and earthquakes, meteorolites — Hydrophobia — Copiapó — Excursion to Cordillera—Dry valley—Cold gales of wind—Noises from a hill—Iquique, complete desert — Salt alluvium — Nitrate of soda — Lima—Unhealthy country—Ruins of Callao, overthrown by earthquake—Elevated shells on island of San Lorenzo—Plain with embedded fragments of pottery.

NORTHERN CHILE AND PERU.

April 27th.—I set out on a journey to Coquimbo, and thence through Guasco to Copiapó, where Captain FitzRoy kindly offered to pick me up in the Beagle. The distance in a straight line along the shore northward is only 420 miles; but my mode of travelling caused me to find it a very long journey. I bought four horses and two mules, the latter carrying the cargo on alternate days. The six animals together only cost the value of twenty-five pounds sterling, and at Copiapó I sold them again for twenty-three. We travelled in the same independent manner as before, cooking our own meals, and sleeping in the open air. As we rode towards the Vino del Mar, I took a farewell view of Valparaiso, and admired its picturesque appearance. For geological purposes I made a detour from the high road to the foot of the Bell mountain. We passed through a highly auriferous district to the neighbourhood of Limache, where we slept. The country is covered with much alluvium, and by the side of each little rivulet it has been washed for gold. This employment supports the inhabitants of numerous scattered hovels; but, like all those who gain by chance, they are unthrifty in their habits.

28th.—In the afternoon we arrived at a cottage at the foot of the Bell mountain. The inhabitants were free-

holders, which is not very usual in Chile. They supported themselves on the produce of a garden and a little field, but were very poor. Capital is so deficient in this part, that the people are obliged to sell their green corn while it is standing in the field, in order to buy necessaries for the ensuing year. Wheat in consequence was dearer in the very district of its production, than at Valparaiso, where the contractors live. The next day we joined the main road to Coquimbo. At night there was a very light shower of rain: this was the first drop that had fallen since the heavy rain of September 11th and 12th, which detained me a prisoner at the baths of Cauquenes. The interval was seven and a half months; but the rain this year in Chile was rather later than usual. The Andes were now covered by a thick mass of snow; and they presented, in the distance, a very glorious sight.

May 2d.—The road continued to follow the coast, at no great distance from the sea. The few trees and bushes which are common in central Chile, decreased rapidly in numbers, and were replaced by a tall plant, something like a yucca in appearance. The surface of the country, on a small scale, was singularly broken and irregular; abrupt little peaks of rock rising out of small plains or basins. The indented coast, and the bottom of the neighbouring sea, studded with breakers, would if converted into dry land, present similar forms; and such a conversion without doubt has taken place in the part over which we rode.

3d.—Quilimari to Conchalee. The country became more and more barren. In the valleys there was scarcely sufficient water for any irrigation; and the intermediate land was quite bare, not supporting even goats. In the spring, after the winter showers, a thin pasture rapidly springs up, and cattle are then driven down from the Cordillera to graze for a short time. It is curious to observe how the seeds of the grass seem to know, as if by an acquired instinct, what quantity of rain to expect. One shower far northward at Copiapó produces as great an effect on the vegetation, as two at Guasco, and as three or four in this district. At Valparaiso a winter

so dry as to injure most seriously the pasture, would at Guasco produce the most unusual abundance. Travelling northward the quantity of rain does not appear to decrease in strict proportion to the distance. At Conchalee, which is only halfway between Valparaiso and Coquimbo (being 67 miles north of the former) rain is not expected till the end of May; whereas, at Valparaiso some generally falls early in April. The annual quantity is likewise small in proportion to the lateness of the season at which it commences.

May 4th.—Finding the coast-road devoid of interest of every kind, we turned inland towards the mining district of Illapel. The town of that name is very regular and pretty. Its flourishing condition depends on numerous mines, chiefly of copper, which occur in its immediate vicinity. This valley, like every other in Chile, is level, broad, and very fertile: it is bordered on each side, either by cliffs of stratified shingle, or by bare rocky mountains. Above the straight line of the uppermost irrigating ditch, all is brown as on a high road; while all below, is of as bright a green as verdigris, from the beds of alfarfa, a kind of clover.

We proceeded to Los Hornos, another mining district, where the principal hill was drilled with holes, like a great ants' nest. The Chilian miners are in their habits a peculiar race of men. Living for weeks together in the most desolate spots, when they descend to the villages on feast-days, there is no excess or extravagance into which they do not run. They sometimes gain a considerable sum, and then, like sailors with prize-money, they try how soon they can contrive to squander it. They drink excessively, buy quantities of clothes, and in a few days return penniless to their miserable abodes, there to work harder than beasts of burden. This thoughtlessness, as with sailors, is evidently the result of a similar manner of life. Their daily food is found them, and they acquire no habitual care as to the means of subsistence: moreover, at the same moment that temptation is offered, the means of enjoying it is placed in their power. On the other hand, in Cornwall, and some other

parts of England, where the system of selling part of the vein is followed, the miners, from being obliged to act for themselves, and to judge with clearness, are a singularly intelligent and well-conducted set of men.

The dress of the Chilian miner is peculiar and rather picturesque. He wears a very long shirt, of some dark-coloured baize, with a leathern apron; the whole being fastened round his waist by a brightly-coloured sash. His trousers are very broad, and his small cap of scarlet cloth is made to fit the head closely. We met a party of these miners in full costume, carrying the body of one of their companions to be buried. They marched at a very quick trot, four men supporting the corpse. One set having run as hard as they could for about two hundred yards, were relieved by four others, who had previously dashed on ahead on horseback. Thus they proceeded, encouraging each other by wild cries: altogether the scene formed a most strange funeral.

We continued travelling northward, in a zigzag line; sometimes stopping a day to geologise. The country was so thinly inhabited, and the track so obscure, that we often had difficulty in finding our way. On the 12th I stayed at some mines. The ore in this case was not considered particularly good, but from being abundant it was supposed the mine would sell for about thirty or forty thousand dollars (that is 6000 or 8000 pounds sterling); yet it was bought by one of the English Associations for an ounce of gold (3*l.* 8*s.*). The ore is yellow pyrites, which as I have already remarked, before the arrival of the English, was not supposed to contain a particle of copper. On a scale of profits, nearly as great as in the above instance, piles of scoriæ abounding with minute globules of metallic copper were purchased; yet with these advantages, the mining associations, as is well known, contrived to lose immense sums of money. The folly of the greater number of commissioners and shareholders, amounted to infatuation:—a thousand pounds per annum given in some cases to entertain the authorities; libraries of well-bound geological books; bringing out miners

for particular metals (as tin) which were soon found not to exist in the country; contracts to supply the miners with milk, in parts where there were no cows; machinery, where such could not possibly be used; and a hundred similar arrangements, bore witness to our absurdity, and to this day afford amusement to the natives. Yet there can be no doubt, that the same capital well employed in these mines would have yielded an immense return: a confidential man of business, a practical miner and assayer, would have been all that was required.

Captain Head has described the wonderful load which the "Apires," truly beasts of burden, carry up from deep mines. I confess I thought the account exaggerated; so that I was glad to take the opportunity of weighing one of the loads, which I picked out by hazard. It required considerable exertion on my part, when standing directly over it, to lift it from the ground. The load was considered under weight when found to be 197 pounds. The apire had carried this up eighty perpendicular yards,—part of the way by a steep passage, but the greater part up notched poles, placed in a zigzag line in the shaft. According to the general regulation, the apire is not allowed to halt for breath, except the mine is six hundred feet deep. The average load is considered as rather more than 200 pounds, and I have been assured that one of 300 pounds (twenty-two stone and a half) by way of a trial has been brought up from the deepest mine! At this time the apires were bringing up the usual load twelve times in the day; that is, 2400 pounds from eighty yards deep; and they were employed in the intervals in breaking and picking ore.

These men, excepting from accidents, are healthy, and appear cheerful. Their bodies are not very muscular. They rarely eat meat once a week, and never oftener, and then only the hard dry charqui. Although with a knowledge that the labour is voluntary, it was nevertheless quite revolting to see the state in which they reached the mouth of the mine; their bodies bent forward, leaning with their arms on the steps, their legs bowed, the muscles quivering, the perspiration

streaming from their faces over their breasts, their nostrils distended, the corners of their mouth forcibly drawn back, and the expulsion of their breath most laborious. Each time, from habit, they utter an articulate cry of "ay-ay," which ends in a sound rising from deep in the chest, but shrill like the note of a fife. After staggering to the pile of ores, they emptied the "carpacho;" in two or three seconds recovering their breath, they wiped the sweat from their brows, and apparently quite fresh descended the mine again at a quick pace. This appears to me a wonderful instance of the amount of labour which habit (for it can be nothing else), will enable a man to endure.

In the evening, talking with the *mayor-domo* of these mines, about the number of foreigners now scattered over the whole country, he told me that, though quite a young man, he remembers when a boy at school at Coquimbo, a holiday being given, to see the captain of an English ship, who was brought to the city to speak to the governor. He believes that nothing would have induced any boy in the school, himself included, to have gone close to the Englishman; so deeply had they been impressed with an idea of the heresy, contamination, and evil to be derived from contact with such a person. To this day they relate the atrocious actions of the bucaniers; and especially of one man, who took away the figure of the Virgin Mary, and returned the year after for that of St. Joseph, saying it was a pity the lady should not have a husband. I heard also of an old lady who, at a dinner in Coquimbo, remarked how wonderfully strange it was that she should have lived to dine in the same room with an Englishman; for she remembered as a girl, that twice, at the mere cry of "Los Ingleses," every soul, carrying what valuables they could, had taken to the mountains.

May 14th.—We reached Coquimbo, where we staid a few days. The town is remarkable for nothing but its extreme quietness. It is said to contain from 6000 to 8000 inhabitants. On the morning of the 17th it rained lightly

(the first time this year) for about five hours. With this shower, the farmers, who plant corn near the sea-coast where the atmosphere is more humid, would break up the ground; with a second, put the seed in: and if a third should fall, they would reap in the spring a good harvest. It was interesting to watch the effect of this trifling amount of moisture. Twelve hours afterwards the ground appeared as dry as ever; yet after an interval of ten days, all the hills were faintly tinged with green patches; the grass being sparingly scattered in hair-like fibres a full inch in length. Before this shower every part of the surface was bare as on a high road.

In the evening, Captain FitzRoy and myself were dining with Mr. Edwards, an English resident well known for his hospitality by all who have visited Coquimbo, when a sharp earthquake happened. I heard the forecoming rumble, but from the screams of the ladies, the running of servants, and the rush of several of the gentlemen to the doorway, I could not distinguish the motion. Some of the women afterwards were crying with terror, and one person said he should not be able to sleep all night, or if he did, it would only be to dream of falling houses. The father of this gentleman had lately lost all his property at Talcahuano, and he himself only just escaped a falling roof at Valparaiso, in 1822. He mentioned a curious coincidence which then happened: he was playing at cards, when a German, one of the party, got up, and said he would never sit in a room in these countries with the door shut, since, owing to his having done so, he had nearly lost his life at Copiapó. Accordingly he opened the door; and no sooner had he done this, than he cried out, "Here it comes again!" and the famous shock commenced. The whole party escaped. The danger in an earthquake is not from the time lost in opening a door, but from the chance of its becoming jammed by the movement of the walls.

It is impossible to be much surprised at the fear which natives and old residents, though some of them known to be men of great command of mind, so generally experience during

earthquakes. I think, however, this excess of panic may be partly attributed to a want of habit in governing their fears; the usual restraint of shame being here absent. Indeed, the natives do not like to see a person indifferent. I heard of two Englishmen who, sleeping in the open air, during a smart shock, knowing there was no danger, did not rise. The natives cried out indignantly, "Look at those heretics, they will not even get out of their beds!"

I spent two or three days in examining the step-formed terraces of shingle first described by Captain Basil Hall, in his work, so full of spirited descriptions, on the west coast of America. Mr. Lyell concluded from the account, that they must have been formed by the sea during the gradual rising of the land. Such is the case: on some of the steps which sweep round from within the valley, so as to front the coast, shells of existing species both lie on the surface, and are embedded in a soft calcareous stone. This bed of the most modern tertiary epoch passes downward into another, containing some living species associated with others now lost. Amongst the latter may be mentioned shells of an enormous perna and an oyster, and the teeth of a gigantic shark, closely allied to, or identical with the *Carcharias Megalodon* of ancient Europe; the bones of which, or of some cetaceous animal, are also present, in a silicified state, in great numbers. At Guasco, the phenomenon of the parallel terraces is very strikingly seen: no less than seven perfectly level, but unequally broad plains, ascending by steps, occur on one or both sides the valley. So remarkable is the contrast of the successive horizontal lines, corresponding on each side, with the irregular outline of the surrounding mountains, that it attracts the attention of even those who feel no interest regarding the causes, which have modelled the surface of the land. The origin of the terraces of Coquimbo is precisely the same, according to my view, with that of the plains of Patagonia; the only difference is that the plains are rather broader than the terraces, and that they front the Atlantic ocean instead of a valley,—which valley, however, was for-

merly occupied by an arm of the sea, but now by a fresh-water river. In every case it must be remembered, that the successive cliffs do not mark so many distinct elevations, but on the contrary, periods of comparative repose during the gradual and perhaps scarcely sensible rise of the land. In the valley of Guasco we have the record of seven such nights of rest, in the action of the subterranean powers.

May 21st.—I set out in company with Don Jose Edwards to the silver-mine of Arqueros, and thence up the valley of Elque or Coquimbo. Passing through a mountainous country, we reached by nightfall the mines belonging to Mr. Edwards. I enjoyed my night's rest here from a cause which will not be fully understood in England, namely, the absence of fleas! The rooms in Coquimbo swarm with them; but they will not live at the elevation of three or four thousand feet, even if brought there, as is constantly occurring at these mines. It can scarcely be the trifling diminution of temperature, but some other cause which is here destructive to these troublesome insects. I spent the greater part of the ensuing day in examining the mines. The veins occur abundantly scattered over several miles of hilly country; yet it is only a few years since that they were discovered by a wood-cutter. The mines are now in a bad state, though they formerly yielded about 2000 pounds in weight of silver a year. It has been said "a person with a copper-mine will gain; with silver he may gain; but with gold he is sure to lose." This is not true: all the large Chilian fortunes have been made by mines of the more precious metals. A short time since an English physician returned to England from Copiapó, taking with him the profits of one share in a silver-mine, which amounted to about 24,000 pounds sterling. No doubt a copper-mine with care is a sure game, whereas the other is gambling, or rather taking a ticket in a lottery.

The owners lose great quantities of rich ores; for no precautions can prevent robbery. I heard of a man laying a bet with another that one of his men should rob him before his face. The ore when brought out of the mine is broken into pieces,

and the useless stone thrown on one side. A couple of the miners who were thus employed, pitched, as if by accident, two fragments away at the same moment, and then cried out for a joke, "Let us see which rolls furthest." The owner, who was standing by, bet a cigar with his friend on the race. The miner by this means watched the very point amongst the rubbish where the stone lay. In the evening he picked it up and carried it to his master, showing him a rich mass of silver ore, and saying, "This was the stone on which you won a cigar by its rolling so far."

May 23d.—We followed up the fertile valley, till we reached an Hacienda, belonging to a relation of Don Jose, where we stayed the ensuing day. I then rode one day's journey further, to see what were declared to be some petrified shells and beans. The former turned out to be so; the latter were small quartz pebbles. We passed through several small villages; and the valley was beautifully cultivated, and the whole scenery very grand. We were here near the main Cordillera; and the surrounding hills were very lofty. In all parts of northern Chile, fruit-trees produce much more abundantly at a considerable elevation near the Andes than in the lower country. The figs and grapes of this part are famous for their superiority, and are cultivated to a great extent. This valley is, perhaps, the most productive one north of Quillota: I believe it contains, including Coquimbo, 25,000 inhabitants. The next day I returned to the Hacienda, and thence, together with Don Jose, to Coquimbo.

June 2d.—We set out for the valley of Guasco, following the coast-road, which was considered rather less desert than the other. Our first day's ride was to a solitary house, called Yerba Buena, where there was pasture for our horses. The shower mentioned as having fallen a fortnight ago, only reached about halfway to Guasco; we had, therefore, in the first part of our journey a most faint tinge of green, which soon faded away. Even where brightest, it was scarcely sufficient to remind one, of the fresh turf and budding flowers during the spring of other countries. While

travelling through these deserts one feels like a prisoner shut up in a gloomy courtyard, longing to see something green and to smell a moist atmosphere.

June 3d.—Yerba Buena to Carizal. During the first part of the day we crossed a mountainous rocky desert; and afterwards a long deep sandy plain, scattered over with broken marine shells. There was very little water, and that little saline; hence the few streamlets were bordered on each side by white incrustations, amongst which succulent salt-loving plants grew. The whole country, from the coast to the Cordillera, is desert and uninhabited. I saw traces only of one living animal in abundance: this was a Bulimus, the shells of which were collected together in extraordinary numbers on the driest spots. In the spring, one humble little plant sends out a few leaves, and on these the snails feed. As they are seen only very early in the morning, when the ground is slightly damp from the dew, the Guasos believe they are born from it. I have observed in other places, that extremely dry and sterile districts, where the soil is calcareous, are most favourable to an extraordinary increase of land-shells. At Carizal there were a few cottages, some brackish water, and a trace of cultivation: but it was with difficulty that we purchased a little corn and straw for our horses.

4th.—Carizal to Sauce. We continued to ride over desert plains, tenanted by large herds of guanaco. We crossed also the valley of Chaneral; which, although the most fertile one between Guasco and Coquimbo, is very narrow, and produces so little pasture, that we could not purchase any for our horses. At Sauce we found a very civil old gentleman superintending a copper-smelting furnace. As an especial favour, he allowed me to purchase at a high price, an armful of dirty straw, which was all the poor horses had for supper after their long day's journey. Very few smelting furnaces are now at work in any part of Chile; it is found more profitable, on account of the extreme scarcity of firewood, and of the loss from the clumsy Chilian method of reduction, to ship the ore for Swansea.

The next day, we crossed some mountains to Freyrina in the valley of Guasco. During each day's ride further northward, the vegetation became more scanty; even the great candlestick cactus was here replaced by a different and much smaller species. During the winter months, both in northern Chile and in Peru, a uniform stratum of clouds hangs (at no great height) over the Pacific. From these mountains we had a very striking view of the great white and brilliant field, which sent arms up the valleys; leaving islands and promontories in the same manner, as the sea now intersects the Chonos archipelago, or the west coast of Tierra del Fuego.

We staid two days at Freyrina. In the valley of Guasco there are four small towns. At the mouth, there is the port, a spot entirely desert, and without any water in the immediate neighbourhood. Five leagues higher up stands Freyrina, a long straggling village, with decent whitewashed houses. Again, ten leagues further up, Ballenar is situated, and above this Guasco Alto, a horticultural village, famous for its dried fruit. On a clear day, the view up the valley is very fine; the straight opening is terminated at a great distance by the outline of the snowy Cordillera; on each side an infinity of crossing lines blend together in a beautiful haze. The foreground is singular, from the number of parallel and extensive terraces; and the included strip of green valley, with its willow bushes, is contrasted on both hands by the naked hills. That the surrounding country was most barren, will be readily believed, from the circumstance of a shower of rain not having fallen during the last thirteen months. The inhabitants heard with the greatest envy of the rain in Coquimbo; from the appearance of the atmosphere they had strong expectations of equally good fortune, which, a fortnight afterwards, was realized. I was at Copiapó at the time; and there the people, with equal envy, talked of the abundant rain at Guasco. After two or three very dry years, perhaps with not more than one shower during the whole time, a rainy year generally follows; and this does more

harm than even the drought. The river swells, and covers with gravel and sand the narrow strip of ground, which alone is fit for cultivation. The flood also injures the irrigating ditches. Great devastation had thus been caused three years ago.

June 8th.—We rode on to Ballenar. As the rocky mountains on each hand were concealed by clouds, the terrace-like plains gave the valley an appearance similar to that of Santa Cruz, in Patagonia. I staid the following day in the town, which is as large as Coquimbo and well built. It has only lately sprung up, and entirely owes its prosperity to some silver-mines. Ballenar takes its name from Ballenagh, in Ireland, the birthplace of the family of O'Higgins, who, under the Spanish government, were presidents and generals in Chile.

10th.—Instead of going direct to the town of Copiapó, I determined to fall into the valley higher up and nearer the Cordillera. We rode all day over an uninteresting country; I am tired of repeating the epithets barren and sterile. These words, however, as commonly used, are comparative: I have always applied them to the plains of Patagonia; yet the vegetation there can boast of spiny bushes and some tufts of grass, which is absolute fertility to any thing that can be seen here. And here again there are not many spaces of two hundred yards square, where some little bush, cactus or lichen, may not be discovered by careful examination; and in the soil seeds lie dormant ready to spring up during the first rainy winter. In Peru real deserts occur, over wide tracts of country. In the evening we arrived at a valley, in which the bed of the streamlet was damp: following it up, we came to tolerably good water. During the night, the stream, before it is evaporated and absorbed, flows a league lower down than during the day. Sticks were plentiful for firewood, so that it was a good place of bivouac for us: but for the poor animals there was not a mouthful for them to eat.

June 11th.—We rode without stopping for twelve hours,

till we reached an old smelting furnace, where there was water and firewood; but our horses again had nothing to eat, being shut up in an old courtyard. The line of road was hilly, and the distant views interesting from the splendid weather, and the varied colours of the bare mountains. It is a pity to see the sun shining constantly over so useless a country; such days should brighten a prospect of fields and gardens. The next day we reached the valley of Copiapó. I was heartily glad of it; for the whole journey was a continued source of anxiety; it was most disagreeable to hear, whilst eating our own supper, our horses gnawing the posts to which they were tied, and to have no means of relieving their hunger. To all appearance, however, the animals were quite fresh; and no one could have told that they had eaten nothing for the last fifty-five hours.

I had a letter of introduction to Mr. Bingley, who received me very kindly at the Hacienda of Potrero Seco. This estate is between twenty and thirty miles long; but it is very narrow, having generally a width of only two fields, one on each side the river. In some parts, the estate is of no width, that is to say, the land cannot be irrigated, and therefore is valueless, like the surrounding rocky desert. The small quantity of cultivated land in the whole line of valley, does not however so much depend on its inequality, or its unfitness for irrigation, as on the small supply of water. The river this year was remarkably full; in this part it reached as high as the horse's belly, and was about fifteen yards wide, and rapid. It gradually decreases in volume till reaching the sea. This latter circumstance, however, rarely happens; and once for a period of thirty years not a drop entered the Pacific. The inhabitants watch a storm over the Cordillera with great interest; as one good fall of snow provides them with water for the ensuing year. This is of infinitely more consequence than rain in the lower country. The latter, as often as it occurs, which is about once in every two or three years, is a great advantage, because the

cattle and mules can for some time afterwards find pasture in the mountains. But without snow in the Andes, desolation extends throughout the valley. It is on record, that three times nearly all the inhabitants have been obliged to emigrate to the south. This year there was plenty of water, and every man irrigated his ground as much as he chose; but it has frequently been necessary to post soldiers at the sluices, to see that each estate took only its proper allowance during so many hours in the week. The valley is said to contain 12,000 souls, but its produce is sufficient only for three months in the year; the rest of the supply being drawn from Valparaiso and the south. Before the discovery of the famous silver-mines of Chanuncillo, Copiapó was in a rapid state of decay; but now it is in a very thriving condition; and the town, which was completely overthrown by an earthquake, has been rebuilt.

The valley of Copiapó, forming a mere ribbon of green in a desert, runs in a very southerly direction; so that it is of considerable length to its origin in the Cordillera. The valleys of Guasco and Copiapó may both be considered as islands to the northward of Chile, separated by deserts instead of salt water. Beyond these, there is one other very miserable valley, called Paposo, which contains about 200 people; and then there extends the real desert of Atacama —a barrier far worse than the most turbulent ocean.

After staying a few days at Potrero Seco, I proceeded up the valley to the house of Don Benito Cruz, to whom I had a letter of introduction. I found him most hospitable; indeed it is impossible to bear too strong testimony to the kindness which travellers receive in almost every part of South America. The next day I hired some mules to take me by the ravine of Jolquera into the central Cordillera. On the second night the weather seemed to foretel a storm of snow or rain, and whilst lying in our beds we felt a trifling shock of an earthquake. The connexion between the latter phenomena and the weather has often been a disputed

point: it appears to me to be one of very great interest, and not well understood. Humboldt* has remarked, "It would be difficult for a person, who has lived a long time in New Andalusia, or in the low regions of Peru, to deny that the season, the most to be dreaded from the frequency of earthquakes, is that of the beginning of the rains, which is, however, the time of thunder-storms. The atmosphere, and the state of the surface of the globe, seem to have an influence unknown to us, on the changes produced at great depths." In Northern Chile, from the extreme infrequency of rain, or even of weather foreboding rain, the probability of accidental coincidences between the two phenomena necessarily becomes very small; yet the inhabitants in that part are most firmly convinced of some connexion between the state of the atmosphere and the tremblings of the ground. I was much struck by this, when mentioning to some people at Copiapó that there had been a sharp shock at Coquimbo: they immediately cried, "How fortunate! there will be plenty of pasture there this year." To their minds an earthquake foretold rain, as surely, as rain foretold abundant pasture. Certainly it did so happen that on the very day of the earthquake, that shower of rain fell, which I have described as in ten days producing a thin sprinkling of grass.

Mr. Scrope has put forth an ingenious idea, that the period of subterranean disturbance, where the force is just on a balance with the resistance, may be determined by a sudden decrease in atmospheric pressure, which over a wide extent of country might produce a considerable effect. According to this explanation, the earthquake comes on at the given period from that state of the weather, which is generally accompanied by rain. But there is another class of phenomena, where the state of the weather evidently

* Personal Narrative, vol. iv., p. 11. In the fourth chapter of the second volume, p. 217, Humboldt, however, appears to think that such connexion is fanciful.

appears a consequence (and not the determining cause) of the earthquake. I allude to those cases, when rain falls at a period of the year, at which it is a greater prodigy than the earthquake itself: I may instance the rain after the shock of November, 1822, at Valparaiso. A person must be somewhat habituated to these climates, to understand the excessive improbability of rain falling at such seasons, except as a consequence of some law quite unconnected with the ordinary course of the weather. In the case of great volcanic eruptions, as that of Coseguina, where torrents of rain fell at a time of year most unusual for it, and "almost unprecedented in Central America,"* it is not difficult to understand that the volumes of vapour and clouds of ashes, might have disturbed the atmospheric equilibrium. Humboldt† extends this view to the case of earthquakes; but for my part, I cannot conceive it possible, that the small quantity of aeriform fluid which at such times escapes from the fissured ground, can produce such remarkable effects.

Humboldt‡ has stated that, "on the days when the earth is shaken by violent shocks, the regularity of the horary variations of the barometer is not disturbed under the tropics. I have verified this observation at Cumana, at Lima, and at Riobamba; and it is so much the more worthy of fixing the attention of natural philosophers, as at St. Domingo, at the town of Cape François, it is asserted, that a water barometer§ was observed to sink two inches and a half immediately

* Caldcleugh. Philosoph. Transact. 1835.

† Personal Narrative, vol. ii., p. 219. ‡ Ibid., p. 217.

§ Courrejolles, in the Journal de Phys., tome liv., p. 106. This depression answers only to two lines of mercury. The barometer remained motionless at Pignerol, in April, 1808. —(Ibid., t. lxvii., p. 292.) [I may add that the earthquake alluded to by Courrejolles at p. 106, was accompanied by a "très-violent coup de vent;" which explains the fall of his water barometer. More lately, Mr. Williams, in his Narrative of Missionary Enterprise (p. 442), has given an account of a hurricane which devastated the Austral islands (S. W. of the Society Archipelago), and which at the Navigator Islands was accompanied by an earthquake. —C. D.]

before the earthquake of 1770. In the same manner it is related, that, at the destruction of Oran, a druggist fled with his family, because observing accidentally a few minutes before the earthquake, the height of the mercury in his barometer, he perceived that the column sunk in an extraordinary manner. I know not whether we can give credit to this assertion." Mr. Alison, in a letter dated Valparaiso, informs me, that just before the earthquake of November, 1822, the mercury in the tube of the barometer standing in his store, sank beneath the graduated part. The tube was a bent one; nineteen inches being exposed, and the lowest graduated part corresponded to twenty-six English inches. With this third case, and more especially considering the unquestionable fact of rain so frequently following severe earthquakes, even at the most unusual seasons, I cannot conclude otherwise, than that there exists some connexion between the subterranean and atmospheric disturbances, of which we are at present quite ignorant.

Mr. Miers,† in his account of the Valparaiso earthquake, November 19th, 1822, has added one more to the list of coincidences between luminous meteors and earthquakes. He says "one of very considerable size, in apparent dimensions little less than the moon, was observed in the southward, at no very great elevation. It traversed a considerable arch of the heavens, leaving behind it a long train of light; and when it disappeared, it seemed to do so from explosion—as it leaped in the same manner as those which eject meteoric stones; but in this instance no noise was heard to attend its extinction, nor was it known that any stones fell. This occurred about half-past two o'clock in the morning after the earthquake." The earthquake itself happened at half-past ten o'clock. Mr. Miers then adds, that a friend of his "travelling on the night of the 4th of November, about a fortnight preceding the great earthquake, observed at a little past eleven o'clock in the *northern* sky,

* Miers's Travels, vol. i., p. 395.

a large meteor of great splendour." It is remarkable that on this same day, according to the Journal of Science,* Copiapó to the *northward* was visited by a severe earthquake, which on the fifth was followed by a much more violent shock. Molina† states that the first shock which announced the great earthquake at midnight on the 24th of May, 1751, "was accompanied by a ball of fire, which precipitated itself from the Andes toward the sea." It is said in the Encyclo. Metropol.—(art. *Meteorology*)—"At Kingston, in Jamaica, in November 1812, a large meteor appeared a few minutes previous to some alarming and tremendous concussions." Aguerros‡ states, on the authority of Ovalle, that in the morning of May 14th, 1633, Carelmapu (north of Chiloe) was overthrown by a bad earthquake, accompanied by a great noise; and that while the people were considering the cause, they saw over a high hill near the village a globe of fire, which appeared to threaten the last day. It rose and quickly proceeded so as to fall in the sea, disturbing the neighbouring waters. This was accompanied by a great tempest, darkness, and a hail-storm, in which pieces of ice fell as large as musket-balls.

I have copied the foregoing notices, because under any point of view, it is remarkable that in one quarter of the globe there should have been so many coincidences between phenomena of not very common occurrence. It must, however, be observed, that the coincidence is not precise; the

* Vol. xvii.

† Molina (Spanish edition), vol. i., p. 33. At six o'clock in the evening of the 26th of May of the same year, that is about thirty-seven hours after the Concepcion earthquake, two meteoric stones fell near Agram in Croatia. They were seen coming *from* the west, which is in an opposite direction to the course of the Chilian meteor. This near coincidence of time was of course only accidental.

‡ Descripcion Historial de Chiloe, p. 104. "Vieron sobre un monte o cerro alto inmediato al pueblo, un globo de fuego que parecia amenazada la ultima desgracia. Elevó se y fué luego a caer al mar, alterando inmediatamente sus aguas."

meteors having been seen in some cases a little before, in others a little after the earthquake. From the account given in Aguerros of the waters of the sea having been disturbed, and from that by Miers of an apparent explosion, it would appear that these meteors must be the same with those that accompany the fall of meteoric stones. This perhaps alone, is an argument that they are accidental accompaniments of earthquakes; for there seems to be no rational method of explaining the origin of meteorolites on any hypothesis directly connected with our world. It is however very singular, that all their constituent parts should be of the same nature as those found on this earth, —that the metals should be chiefly those most subject to magnetic influence,—and that olivine should frequently be present; a mineral* which is exclusively confined to a certain class of volcanic products.

To return to the valley of Copiapó. Finding little of interest in this part of the ravine, we retraced our steps to the house of Don Benito, where I staid two days collecting fossil shells and silicified wood. The latter was present in the most extraordinary quantity: it was here that I found a cylindrical trunk, fifteen feet in circumference, projecting from the side of a hill. It was amusing to hear discussions concerning the nature of the fossil shells,—whether or not they had been thus "born by nature,"—carried on almost in the same terms as were used a century before in Europe. My geological examination of the country generally created a good deal of surprise amongst the Chilenos: it was long before they would be convinced that I was not hunting for mines. This was sometimes troublesome. I found the most

* Olivine is known to accompany basaltic in opposition to clinkstone rocks. Gmelin says, "Natron and potash characterize clinkstone; iron and magnesia, basalt." "Magnesia and iron show a great tendency to enter into combination with each other." These two latter substances are main constituents of meteoric stones, while the alkalies are generally present in very small quantities. Gmelin on Clinkstone, Edinburgh New Philosoph. Journal, April, 1829.

ready way of explaining my employment, was to ask them how it was that they themselves were not curious concerning earthquakes and volcanoes?—why some springs were hot and others cold?—why there were mountains in Chile, and not a hill in La Plata? These bare questions at once satisfied and silenced the greater number; some, however (like a few in England who are a century behindhand), thought that all such inquiries were useless and impious; and that it was quite sufficient that God had thus made the mountains.

An order had recently been issued that all stray dogs should be killed, and we saw many carcasses lying on the high road. A great number had lately been affected with hydrophobia, and several men had been bitten, and had died in consequence. On other occasions hydrophobia has prevailed in this valley. It is remarkable thus to find so strange and dreadful a disease appearing time after time in the same isolated spot. It has been remarked that certain villages in England are in like manner much more subject to this visitation than others. Hydrophobia must be extremely rare on the eastern side of the Andes, for Azara thought it was unknown in America; and Ulloa says the same with respect to Quito. I could not hear of a case having occurred in Van Diemen's Land, or in Australia; and Burchell says, during the five years he was at the Cape of Good Hope, he never heard of an instance of it. Webster again asserts that at the Azores, hydrophobia has never occurred; and the same observation has been made with respect to Mauritius and St. Helena.* In so strange a disease, some information might possibly be gained by considering the circumstances under which it originates in distant climates.

At night, a stranger arrived at the house of Don Benito, and asked permission to sleep there. He said he had been

* Azara's Travels, vol. i., p. 381.—Ulloa's Voyage, vol. ii., p. 28.—Burchell's Travels in Southern Africa, vol. ii., p. 524.—Webster's Description of the Azores, p. 124.—Voyage à l'Isle de France par un Officier du Roi, tome i., p. 248.—Description of St. Helena, p. 123.

wandering about the mountains for seventeen days, having lost his way. He started from Guasco, and being accustomed to the mountains, did not expect any difficulty in following the track to Copiapó; but he soon became involved in a labyrinth of mountains, whence he could not escape. Some of his mules had fallen over precipices, and he had been in great distress. His chief difficulty arose from not knowing where to find water in the lower country, so that he was obliged to keep bordering the central ranges.

We returned down the valley, and on the 22d reached the town of Copiapó. The lower part of the valley is broad, forming a fine plain like that of Aconcagua or Quillota. The town covers a considerable space of ground, each house possessing a garden: but it is an uncomfortable place, and the dwellings are poorly furnished. Every one seems bent on the one object of making money, and then migrating as quickly as possible. All the inhabitants are more or less directly concerned with mines; and mines and ores are the the sole subjects of conversation. Necessaries of all sorts are very dear; as the distance from the town to the port is eighteen leagues, and the land carriage very expensive. A fowl costs five or six shillings; meat is nearly as dear as in England; firewood, or rather sticks, are brought on donkeys from a distance of two and three days' journey within the Cordillera; and pasturage for animals is a shilling a day: all this for South America is wonderfully exorbitant.

June 26th.—I hired a guide and eight mules to take me into the Cordillera by a different line from my last expedition. As the country was utterly desert, we took a cargo and a half of barley mixed with chopped straw. About two leagues above the town, a broad valley called the "Despoblado," or uninhabited, branches off from the one by which we had descended. Although a valley of the grandest dimensions, and leading to a pass across the Cordillera, yet it is completely dry, excepting perhaps, for a few days during some very rainy winter. The bottom of the main valley was nearly flat, and the sides of the crumbling mountains were

but little furrowed by ravines. No considerable river could ever have poured its waters over the bed of shingle, without having excavated a channel similar to those occurring in the southern valleys. I feel little doubt that it was left in the state we now see it, by the gradually retiring sea. The dry valleys mentioned by travellers in Peru, probably owe their origin to a similar agency, and not to the running streams of any former period. I observed in one place, where a ravine (which amongst any other mountains would have been called a grand valley), joined the Despoblado, that the bed of the latter, though composed merely of sand and gravel, was higher than that of its tributary. A mere rivulet of water, in the course of an hour, would have cut a channel for itself; but it was evident that centuries had passed away, and no such rivulet had drained these great valleys. It was curious to behold this machinery (if such a term may be used) for the drainage, all, with the last trifling exception, perfect, yet without any signs of activity. Every one must have remarked how mud-banks, left by the retiring tide, imitate in miniature a country with hill and dale: and here we find a model, only on a grander scale, formed by the waves of a retiring ocean. Let thousands of years replace minutes of the tidal change, and the difference between soft mud and hard rock will barely modify the result. If a shower of rain falls on the mud-bank, when left dry, it deepens the shallow lines of excavation: and so will it be with the rain of successive centuries on the bank of rock and soil, which we call a continent.

We rode on after it was dark, till we reached a side ravine, with a small well called "Agua amarga." The water deserved its name, for besides being saline it was most offensively putrid and bitter; so that we could not force ourselves to drink either tea or maté. I suppose the distance from the river of Copiapó to this spot was at least twenty-five or thirty English miles; in the whole space there was not a single drop of water, the country almost deserving the name of desert in the strictest sense. Yet about halfway we passed the old Indian ruins near Punta Gorda, which I

have already mentioned. I noticed also in front of some of the valleys, which branch off from the Despoblado, two piles of stones placed a little distance apart, and directed so as to point up the mouth of the small valley. My companions knew nothing about them, and only answered my queries by their imperturbable "quien sabe?"

JUNE 27TH.—We set out early in the morning, and by mid-day reached the ravine of Paypote, where there is a tiny rill of water, with a little vegetation, and even a few algarroba (a mimosa) trees. On this latter account a smelting furnace had formerly been built here. We found a solitary man in charge of it, whose sole employment was hunting guanacoes. At night it froze sharply; but having plenty of firewood, we kept ourselves warm.

28TH.—We continued gradually ascending as we followed the valley, which now had assumed the character of a ravine. During the day we saw several guanacoes, and the track of the closely-allied species, called the Vicuna. This latter animal is pre-eminently alpine in its habits; it seldom descends much below the limit of perpetual snow, and therefore haunts even a more lofty and sterile situation than the guanaco. The only other animal which we saw in any number was a small fox. I suppose this animal preys on the mice and other small rodents, which, as long as there is the least vegetation subsist in considerable numbers in very desert places. In Patagonia, even on the borders of the salinas, where a drop of fresh water can never be found, these little animals swarm. Next to lizards, mice appear to be able to support existence on the smallest and driest portions of the earth,—even on islets in the midst of great oceans. I believe it will be found, that several islands, which possess no other warmblooded quadruped, have small rodents peculiar to themselves.

The scenery on all sides showed desolation, brightened, and made palpable, by a clear, unclouded sky. Custom excludes the feeling of sublimity, and when this is wanting, such scenery is rather the reverse of interesting. We

bivouacked at the "primera linea," or the first line of the partition of the waters. The streams, however, on the east side do not flow to the Atlantic, but into an elevated district, in the middle of which there is a large salina, or salt lake;—thus forming a little Caspian sea at the elevation, perhaps, of ten thousand feet. Where we slept, there were some considerable patches of snow, but they do not remain throughout the year. The winds in these lofty regions obey very regular laws: every day a fresh breeze blows up the valley, and at night, an hour or two after sunset, the air from the cold regions above descends, as through a funnel. This night it blew a gale of wind, and the temperature must have been considerably below the freezing-point, for water in a short time became a block of ice. No clothes seemed to oppose any obstacle to the air; I suffered very much from the cold, so that I could not sleep, and in the morning rose with my body quite dull and benumbed.

In the Cordillera further southward, people lose their lives from snow-storms; here, this sometimes happens from another cause. My guide, when a boy of fourteen years old, was passing the Cordillera with some others, in the month of May; and while in the central parts, a furious gale of wind arose so that the men could hardly stick on their mules, and stones were flying along the ground. The day was cloudless and not a speck of snow fell, but the temperature was low. It is probable that the thermometer would not have stood very many degrees below the freezing-point, but the effect on their bodies, ill protected by clothing, would be in proportion to the rapidity of the current of cold air. The gale lasted for more than a day; the men began to lose all their strength, and the mules would not move onwards. My guide's brother tried to return, but he perished, and his body was found two years afterwards, lying by the side of his mule near the road, with the bridle still in his hand. Two other men in the party lost their fingers and toes, and out of two hundred mules and thirty cows, only fourteen of the former escaped alive. Many years ago the whole of a large

party are supposed to have perished from a similar cause, but their bodies to this day have never been discovered. The union of a cloudless sky, low temperature, and a furious gale of wind, must be I should think, in all parts of the world, an unusual occurrence.

June 29th.—We gladly travelled down the valley to our former night's lodging, and thence to near the Agua amarga. On July 1st, we reached the valley of Copiapó. The smell of the fresh clover was quite delightful, after the scentless air of the dry sterile Despoblado. Whilst staying in the town, I heard an account from several of the inhabitants of a hill in the neighbourhood, which they called "El Bramador,"—the roarer or bellower. I did not at the time pay sufficient attention to the account; but as far as I understood, the hill was covered by sand, and the noise was produced only when people, by ascending it, put the sand in motion. Upon reading an article in the Edinburgh Journal,* I was surprised to find the same circumstances, described in detail on the authority of Seetzen and Ehrenbergh, as the cause of the sounds, which have been heard by many travellers on Mount Sinai near the Red Sea. One person with whom I conversed had himself heard the noise; he described it as very surprising; and he distinctly stated, that although he could not understand how it was effected, yet it was necessary to set the sand rolling down the acclivity. I can vouch for the quantity of loose sand lying on the bare granite mountains in this neighbourhood. From the position of the hill, and from the account which I received, the phenomenon certainly does not appear to have any direct connexion with volcanic causes. I may remark that a horse walking over dry and coarse sand, causes a peculiar chirping noise from the friction of the particles: a fact which I have several times noticed on the coast of Brazil.

Three days afterwards I heard of the Beagle's arrival at

* Edinburgh Philosophical Journal, January, 1830, p. 74. Also, another article in the number for April in the same year, p. 258. See also Daubeny on Volcanoes, p. 438.

the port, which is distant eighteen leagues. There is very little land cultivated below the town. The wide expanse of the valley supports a wretched wiry grass, which even the donkeys can hardly eat. This poorness of the vegetation is owing to the quantity of saline matter with which the soil is impregnated. Layers of sulphate and carbonate of soda, even several inches thick, occur in some parts. The port consists of an assemblage of miserable little hovels, situated at the foot of some sterile plains and hills. At present, from the river reaching the sea, the inhabitants enjoy the advantage of having fresh water within a mile and a half. On the beach there were large piles of merchandise, and the little place had an air of activity. In the evening I gave my adios with a hearty good will, to my companion Mariano Gonzales, with whom I had ridden so many leagues in Chile. The next morning the Beagle sailed for Iquique, lat. 20° 12′ on the coast of Peru.

July 12th.—We anchored in the port of Iquique. The town contains about a thousand inhabitants, and stands on a little plain of sand at the foot of a great wall of rock, 2000 feet in height, which here forms the coast. The whole is utterly desert. A light shower of rain falls only once in very many years; and hence the ravines are filled with detritus, and the mountain sides covered by piles of fine white sand, even a thousand feet high. During this season of the year, a heavy bank of clouds extending parallel to the ocean, seldom rises above the wall of rocks on the coast. The aspect of the place was most gloomy; the little port, with its few vessels, and small group of wretched houses, seemed overwhelmed and out of all proportion with the rest of the scene.

The inhabitants live like persons on board a ship; every necessary coming from a distance. Water is brought in boats from Pisagua, about forty miles to the northward and is sold at the rate of nine reals (4*s.* 6*d.*) an eighteen-gallon cask: I bought a wine-bottle full for threepence. In like

manner firewood, and of course every article of food, is imported. Very few animals can be maintained in such a place: on the ensuing morning I hired, with difficulty at the price of four pounds sterling, two mules and a guide to take me to the saltpetre works. These are the present support of Iquique. During one year the value of one hundred thousand pounds sterling was exported to France and England. This saltpetre does not properly deserve to be so called; for it consists of nitrate of soda, and not of potash, and is therefore of much less value. It is said to be principally used in the manufacture of nitric acid. Owing to its deliquescent property it will not serve for gunpowder. Formerly there were two exceedingly rich silver-mines in this neighbourhood, but they now produce very little.

Our arrival in the offing caused some little apprehension. Peru was in a state of anarchy; and each party having demanded a contribution, the poor town of Iquique was in tribulation, thinking the evil hour was come. The people had also their domestic troubles; a short time before, three French carpenters had broken open the two churches, during the same night, and stolen all the plate: one of the robbers, however, subsequently confessed, and the plate was recovered. The convicts were sent to Arequipa, which, though the capital of this province, is 200 leagues distant: the government there thought it a pity to punish such useful workmen, who could make all sorts of furniture; and accordingly liberated them. Things being in this state, the churches were again broken open, but the plate this time was not recovered. The inhabitants became dreadfully enraged, and declaring that none but heretics would thus "eat God Almighty," proceeded to torture some Englishmen, with the intention of afterwards shooting them. At last the authorities interfered, and peace was established.

July 13th.—In the morning I started for the saltpetre works, a distance of fourteen leagues. Having ascended the steep coast mountains by a zigzag sandy track, we soon came in view of the mines of Guantajaya and St. Rosa. These

two small villages are placed at the very mouths of the mines. If the town of Iquique appeared desolate, these, perched up on hills, had a still more unnatural aspect. We did not reach the saltpetre works till after sunset, having ridden all day across an undulating country, a complete and utter desert. The road was strewed with the bones and dried skins of the many beasts of burden, which had perished on it from fatigue. Excepting the Vultur aura, which preys on the carcasses, I saw neither bird, quadruped, reptile, or insect. On the coast mountains, at the elevation of about 2000 feet, where during this season the clouds generally hang, a very few cacti were growing in the clefts of rock; and the loose sand was strewed over with a simple lichen, which lies on the surface quite unattached. This plant belongs to the genus Cladonia, and somewhat resembles the reindeer lichen. In some parts it was in sufficient quantity to tinge the sand, as seen from a distance, of a pale yellowish colour. Further inland, during the whole ride of fourteen leagues, I saw only one other vegetable production, and that was a most minute yellow lichen, growing on the bones of the dead mules. This was the first true desert which I had seen: the effect on me was not impressive; but I believe this was owing to my having become gradually accustomed to such scenes, as I rode northward from Valparaiso, through Coquimbo to Copiapó. The appearance of the country was remarkable, from being covered by a thick crust of common salt, and of a saliferous sandstone, which properly deserves the name of alluvium. The salt is white, very hard, and compact. It occurs in water-worn nodules, which project from the agglutinated sand or soft sandstone. The appearance of this superficial mass, very closely resembled that of a country after snow, before the last dirty patches have thawed. The rocks of which the mountains are composed are saliferous; and I imagine, the very small quantity of rain that falls, is sufficient only to wash the salt from the higher strata, and that afterwards it concretes in nodules and patches, in the sandy soil of the valleys. Whatever its origin

may be, the existence of a crust of a soluble substance over the whole face of the country, shows how extraordinarily dry the climate must have been for a period long antecedent.

At night I slept at the house of the owner of one of the saltpetre mines. The country is here equally unproductive with that near the coast; but water, though having rather a bitter and brackish taste, can be procured by digging. The well at this house was thirty-six yards deep. As scarcely any rain falls, it is evident the water is not derived from that source; indeed if it were, it could not fail to be as salt as brine, for the whole surrounding country is incrusted with various saline substances. We must therefore conclude that it percolates from some distant and more humid region, probably the mountains of the higher Cordillera. In that direction there are a few small villages, such as Tarapaca, where the inhabitants, having more water, are enabled to irrigate some little land, and produce hay, on which the mules and asses employed in carrying the saltpetre are fed.

The nitrate of soda is sold at the ship's side at fourteen shillings per hundred pounds. The chief expense is the transport to the sea-coast. The mine itself consists of a stratum between two and three feet thick, of the hard and nearly pure salt, lying close beneath the surface. The stratum follows the margin of a grand basin or plain, which manifestly must once have been either a lake or inland sea: the elevation at present is 3300 feet above the level of the Pacific. On our return we made a detour by the mines of Guantajaya. The village consists solely of the houses of the miners, and the place is utterly destitute of every necessary;—even water being brought thirty miles on the backs of animals. At present the mines yield little; though formerly they were very productive. One has a depth of four hundred yards, and out of it masses of silver were taken so pure, that it was only required to melt them in order to run them into bars. We reached Iquique after sunset: I went on board, and then the Beagle weighed for Lima. I was very glad to have seen

this place, as I understand it is a good type of the greater part of the coast of Peru.

July 19th.—We anchored in the bay of Callao, the sea-port of Lima, the capital of Peru. We staid here six weeks, but from the troubled state of public affairs, I saw very little of the country. During our whole visit the climate was far from being so delightful as it is generally represented. A dull heavy bank of clouds constantly hung over the land, so that during the first sixteen days I had only one view of the Cordillera behind Lima. These mountains, seen in stages, one above the other, through openings in the clouds, had a very grand appearance. It has almost become a proverb, that rain never falls in the lower part of Peru. Yet this can hardly be considered correct; for during almost every day of our visit there was a thick drizzling mist, which was sufficient to make the streets muddy and one's clothes damp: this the people are pleased to call Peruvian dew. That much rain does not fall is very certain, for the houses are covered only with flat roofs made of hardened mud; and on the mole, ship-loads of wheat were piled up, and are thus left for weeks together without any shelter.

I cannot say I liked the very little I saw of Peru: in summer, however, it is said that the climate is much pleasanter. In all seasons, both inhabitants and foreigners suffer from severe attacks of ague. This disease is common on the whole coast of Peru, but is unknown in the interior. The attacks of illness which arise from miasma never fail to appear most mysterious. So difficult is it to judge from the aspect of a country, whether or not it is healthy, that if a person had been told to choose within the tropics a situation appearing favourable for health, very probably he would have named this coast. The plain round the outskirts of Callao is sparingly covered with a coarse grass, and in some parts there are a few stagnant, though very small, pools of water. The miasma, in all probability, arises from these:

for the town of Arica was similarly circumstanced, and its healthiness was much improved by the drainage of the water. The miasma is not always produced by a luxuriant vegetation with an ardent climate; for many parts of Brazil, even where there are marshes and a rank vegetation, are much more healthy than this sterile coast of Peru. The densest forests in a temperate climate, as in Chiloe, do not seem in the slightest degree to affect the healthy condition of the atmosphere.

The island of St. Jago, at the Cape de Verds, offers another strongly-marked instance of a country which any one would have expected to find most healthy, being very much the contrary. I have described the bare and open plains as supporting, during a few weeks after the rainy season, a thin vegetation, which directly withers away and dries up: at that period the air appears to become poisonous; both natives and foreigners often becoming affected with violent fevers. On the other hand, the Galapagos Archipelago, in the Pacific, with a similar soil, and periodically subject to the same process of vegetation, is perfectly healthy. Humboldt has observed, that, "under the torrid zone, the smallest marshes are the most dangerous, being surrounded, as at Vera Cruz and Carthagena, with an arid and sandy soil, which raises the temperature of the ambient air."* I must observe, however, that on the coast of Peru the temperature is not hot to any excessive degree; and perhaps in consequence, the intermittent fevers are not of the most malignant order.

In all unhealthy countries the greatest risk is run by sleeping on shore. Is this owing to the state of the body during sleep, or to a greater abundance of miasma at such times? It appears certain that those who stay on board a vessel, though anchored at only a short distance from the coast, generally suffer less than those actually on shore. On

* Political Essay on the Kingdom of New Spain, vol. iv., p. 199.

the other hand, I have heard of one remarkable case where a fever broke out among the crew of a man-of-war some hundred miles off the coast of Africa, at the very same time that one of those fearful periods of death commenced at Sierra Leone. It may be remarked, that of the most destructive diseases, which bear an evident relation to climate, and which (as if by the addition of some direct poison) affect both natives and strangers, nearly all originate in the hotter regions of the earth. As geological induction shows that the climate, during the periods antecedent to the present, had an extra-tropical character, so, in all probability, there would be an extra tendency to disease, and we can therefore see that the introduction of man being, as generally supposed, recent, is an adaptation to the existing condition of the world.

No state in South America, since the declaration of independence, has suffered more from anarchy than Peru. At the time of our visit there were four chiefs in arms contending for supremacy in the government: if one succeeded in becoming for a time very powerful, the others coalesced against him; but no sooner were they victorious, than they were again disunited, and hostile to each other. The other day, at the Anniversary of the Independence, high mass was performed, the President partaking of the sacrament: during the *Te Deum laudamus*, instead of each regiment displaying the Peruvian flag, a black one with death's head was unfurled. Imagine a government under which such a scene could be ordered, on such an occasion, to be typical of their determination of fighting to the death! This state of affairs happened at a time very unfortunately for me, as I was precluded from taking any excursions much beyond the limits of the towns. The barren island of S. Lorenzo, which forms the harbour, was nearly the only place where one could walk securely. The upper part, which is about 1200 feet in height, during this season of the year, (winter) comes within the lower limit of

the clouds; and in consequence of this, an abundant cryptogamic vegetation, and a few flowers, covered the summit. On the hills near Lima, at an elevation but little greater, the ground was carpeted with moss, and beds of beautiful yellow lilies, called Amancaes. This indicates a very much greater degree of humidity than at a corresponding altitude at Iquique. Travelling northward, the climate becomes damper, till on the banks of the Guyaquil, nearly under the equator, we find the most luxuriant forests. The change, however, from the sterile coast of Peru to that fertile land, is described as taking place rather abruptly, in the latitude of Cape Blanco, two degrees south of Guyaquil.

Callao is a filthy, ill-built, small seaport. The inhabitants, both there and at Lima, present every imaginable shade of mixture, between European, Negro, and Indian blood. They appear a depraved, drunken set of people. The atmosphere was loaded with foul smells, and that peculiar one, which may be perceived in almost every town within the tropics, was here very strong. The fortress, which withstood Lord Cochrane's long siege, has an imposing appearance. But the President, during our stay, sold the brass guns, and proceeded to dismantle parts of it. The reason assigned was, that he had not an officer to whom he could trust so important a charge. He himself had good reasons for knowing this, as he had obtained the presidentship by rebelling while in charge of this same fortress. After we left South America, he paid the penalty in the usual way, by being conquered, taken prisoner, and shot.

Lima stands on a plain in a valley, formed during the gradual retreat of the sea. It is distant seven miles from Callao, and is elevated 500 feet above it; but from the slope being very gradual, the road appears absolutely level; so that when at Lima it is difficult to believe one has ascended some hundred feet. Humboldt has remarked on this singularly deceptive case. Steep, barren hills rise like islands from the plain, which is divided, by straight mud-walls, into large green fields. In these scarcely a tree grows excepting a

few willows; and the presence of an occasional clump of bananas and of oranges, alone reminded one that the landscape of a country in latitude 12° might have boasted of a far more splendid vegetation. The city of Lima is now in a wretched state of decay: the streets are nearly unpaved, and heaps of filth are piled up in all directions; where the black gallinazos, tame as poultry, pick up bits of carrion. The houses have generally an upper story, built, on account of the earthquakes, of plastered woodwork; but some of the old ones, which are now used by several families, are immensely large, and would rival in suites of apartments the most magnificent in any place. Lima, the City of the Kings, must formerly have been a splendid town. The extraordinary number of churches, even at the present day, gives it a peculiar and striking character, especially when viewed from a short distance.

One day I went out with some merchants to hunt in the immediate vicinity of the city. Our sport was very poor; but I had an opportunity of seeing the ruins of one of the ancient Indian villages, with its hill-like mound in the centre. The remains of houses, enclosures, irrigating streams, and burial mounds, scattered over this plain, cannot fail to give one a high idea of the condition and number of the ancient population. When their earthenware, woollen clothes, utensils of elegant forms cut out of the hardest rocks, tools of copper, ornaments of precious stones, palaces and hydraulic works, are considered, it is impossible not to respect the considerable advance made by them in the arts of civilization. The burial mounds, called Huacas, are really stupendous; although in some places it is only a natural hill which appears to have been incased and modelled.

There is also another and very different class of ruins, which possesses some interest, namely, those of old Callao, overwhelmed by the great earthquake of 1746, and its accompanying wave. The destruction must have been more complete even than at Concepcion. Quantities of shingle almost conceal the foundations of the walls, and vast masses of

brickwork appear to have been whirled about by the retiring waves like pebbles. It has been stated that the land subsided during this memorable shock: I could not discover any proof of this; yet it seems far from improbable, for the form of the coast must certainly have undergone some change since the foundation of the old town; as no people in their senses would willingly have chosen for their building place the narrow spit of shingle on which the ruins now stand. On the island of San Lorenzo, there are very satisfactory proofs of elevation within the recent period: this of course would not contravene the belief of a small subsidence, if any signs of such movement could be discovered. The side of the mountain fronting the bay on that island, is worn into three obscure terraces, which are covered by masses of shells many hundred tons in weight, of species now existing on the beach. Several of the univalves had serpulæ and small balani attached on their insides; proving that they must have remained some time, after the animal had died, at the bottom of the sea. In such cases we may feel sure that they had not been carried up, as has sometimes been believed, either by birds or men for food.

When examining the beds of shells, which have been raised above the level of the sea, on other parts of the coast, I often felt curious to trace their final disappearance from decay. On the island of San Lorenzo, this could be done in the most satisfactory manner: at a small height the shells were quite perfect; on a terrace, eighty-five feet above the sea, they were partially decomposed and coated by a soft scaly substance; at double this altitude a thin layer of calcareous powder beneath the soil, without a trace of organic structure, was all that could be discovered. This highly curious and satisfactory gradation of change, it is evident could be traced only under the peculiar conditions of this climate, where rain never falls so as to wash away the particles of shells in their last stage of decomposition. I was much interested by finding embedded, together with pieces of sea-weed in the mass of shells, in the eighty-five foot bed, a bit of *cotton-thread*,

plaited rush, and the head of a stalk of Indian corn. This fact, coupled with another, which will be mentioned, proves I think the amount of eighty-five feet elevation since man inhabited this part of Peru. On the coast of Patagonia and La Plata, where perhaps the movements have been slower, there is evidence, as we have seen, that several mammalia have become extinct during a smaller change of level. At Valparaiso, where there exist abundant proofs of recent elevation to a greater altitude than in this part of Peru, I can show that the greatest possible change during the last 220 years, has not exceeded the small measure of fifteen feet.

On the mainland in front of San Lorenzo, near Bellavista, there is an extensive and level plain, at the height of about a hundred feet. The section on the coast shows that the lower part consists of alternating layers of sand and impure clay, together with some gravel; and the surface, to the depth of from three to six feet, of a reddish loam, containing a few scattered sea-shells, and numerous small fragments of coarse red earthenware. At first I was inclined to believe that this superficial bed must have been deposited beneath the sea; but I afterwards found in one spot, that it covered an artificial floor of round stones. The conclusion which then seemed most probable was, that at a period when the land stood at a less height, there was a plain very similar to the one now surrounding Callao, which being protected by a shingle beach, is raised but very little above the level of the sea. On this plain, with its clay beds, I imagine the Indians manufactured their earthen vessels; and that, during some violent earthquake, the sea broke over the beach and converted the plain into a temporary lake, as happened in 1713* around Callao. The water would then deposit mud, containing fragments of pottery from the kilns, and shells from the sea. This bed with fossil earthenware occurring at about the same altitude with the terrace on San Lorenzo, confirms the supposed amount of elevation within the human period.

* Frezier's Voyage.

CHAPTER XIX.

Islands volcanic—Number of craters—Leafless bushes—Colony at Charles Island—James Island—Salt-lake in crater—Character of vegetation—Ornithology, curious finches—Great tortoises, habits of, paths to the wells—Marine lizard feeds on sea-weed—Terrestrial species, burrowing habits, herbivorous—Importance of reptiles in the Archipelago—Few and minute insects—American type of organization—Species confined to certain islands—Tameness of birds—Falkland Islands—Fear of man an acquired instinct.

GALAPAGOS ARCHIPELAGO.

SEPTEMBER 15TH.—The Beagle arrived at the southernmost of the Galapagos islands. This archipelago consists of ten principal islands, of which five much exceed the others in size. They are situated under the equatorial line, and between five and six hundred miles to the westward of the coast of America. The constitution of the whole is volcanic. With the exception of some ejected fragments of granite, which have been most curiously glazed and altered by the heat, every part consists of lava, or of sandstone resulting from the attrition of such materials. The higher islands, (which attain an elevation of three, and even four thousand feet) generally have one or more principal craters towards their centre, and on their flanks smaller orifices. I have no exact data from which to calculate, but I do not hesitate to affirm, that there must be, in all the islands of the archipelago, at least two thousand craters. These are of two kinds; one, as in ordinary cases, consisting of scoriæ and lava, the other of finely-stratified volcanic sandstone. The latter in most instances have a form beautifully symmetrical: their origin is due to the ejection of mud,—that is, fine volcanic ashes and water,—without any lava.

Considering that these islands are placed directly under the equator, the climate is far from being excessively hot; a

circumstance which, perhaps, is chiefly owing to the singularly low temperature of the surrounding sea. Excepting during one short season, very little rain falls, and even then it is not regular: but the clouds generally hang low. From these circumstances the lower parts of the islands are extremely arid, whilst the summits, at an elevation of a thousand feet or more, possess a tolerably luxuriant vegetation. This is especially the case on the windward side, which first receives and condenses the moisture from the atmosphere.

In the morning (17th,) we landed on Chatham Island, which, like the others, rises with a tame and rounded outline, interrupted only here and there by scattered hillocks—the remains of former craters. Nothing could be less inviting than the first appearance. A broken field of black basaltic lava is every where covered by astunted brushwood, which shows little signs of life. The dry and parched surface, having been heated by the noonday sun, gave the air a close and sultry feeling, like that from a stove: we fancied even the bushes smelt unpleasantly. Although I diligently tried to collect as many plants as possible, I succeeded in getting only ten kinds; and such wretched-looking little weeds would have better become an arctic, than an equatorial Flora.

The thin woods, which cover the lower parts of all the islands, excepting where the lava has recently flowed, appear from a short distance quite leafless, like the deciduous trees of the northern hemisphere in winter. It was some time before I discovered, that not only almost every plant was in full leaf, but that the greater number were now in flower. After the period of heavy rains, the islands are said to appear for a short time partially green. The only other country, in which I have seen a vegetation with a character at all approaching to this, is at the volcanic island of Fernando Noronha, placed in many respects under similar conditions.

The natural history of this archipelago is very remarkable: it seems to be a little world within itself; the greater number of its inhabitants, both vegetable and animal, being found

nowhere else. As I shall refer to this subject again, I will only here remark, as forming a striking character on first landing, that the birds are strangers to man. So tame and unsuspecting were they, that they did not even understand what was meant by stones being thrown at them; and quite regardless of us, they approached so close that any number might have been killed with a stick.

The Beagle sailed round Chatham Island, and anchored in several bays. One night I slept on shore, on a part of the island where some black cones—the former chimneys of the subterranean heated fluids—were extraordinarily numerous. From one small eminence, I counted sixty of these truncated hillocks, which were all surmounted by a more or less perfect crater. The greater number consisted merely of a ring of red scoriæ, or slags, cemented together: and their height above the plain of lava, was not more than from fifty to a hundred feet. From their regular form, they gave the country a *workshop* appearance, which strongly reminded me of those parts of Staffordshire where the great iron-foundries are most numerous.

The age of the various beds of lava was distinctly marked by the comparative growth, or entire absence, of vegetation. Nothing can be imagined more rough and horrid than the surface of the more modern streams. These have been aptly compared to the sea petrified in its most boisterous moments: no sea, however, would present such irregular undulations, or would be traversed by such deep chasms. All the craters are in an extinct condition; and although the age of the different streams of lava could be so clearly distinguished, it is probable they have remained so for many centuries. There is no account in any of the old voyagers of any volcano on this island having been seen in activity; yet since the time of Dampier (1684), there must have been some increase in the quantity of vegetation, otherwise so accurate a person would not have expressed himself thus:—"Four or five of the easternmost islands are rocky, barren, and hilly, producing neither

tree, herb, nor grass, but a few dildoe (cactus) trees, except by the sea-side."* This description is at present applicable only to the western islands, where the volcanic forces are in frequent activity.

The day, on which I visited the little craters, was glowing hot, and the scrambling over the rough surface, and through the intricate thickets, was very fatiguing; but I was well repaid by the Cyclopian scene. In my walk I met two large tortoises, each of which must have weighed at least two hundred pounds. One was eating a piece of cactus, and when I approached, it looked at me, and then quietly walked away: the other gave a deep hiss and drew in its head. These huge reptiles, surrounded by the black lava, the leafless shrubs, and large cacti, appeared to my fancy like some antediluvian animals.

September 23d.—The Beagle proceeded to Charles Island. This archipelago has long been frequented, first by the Bucaniers, and latterly by whalers, but it is only within the last six years, that a small colony has been established on it. The inhabitants are between two and three hundred in number: they nearly all consist of people of colour, who have been banished for political crimes from the Republic of the Equator (Quito is the capital of this state) to which these islands belong. The settlement is placed about four and a half miles inland, and at an elevation probably of a thousand feet. In the first part of the road we passed through leafless thickets, as in Chatham Island. Higher up, the wood gradually became greener; and immediately we had crossed the ridge of the island, our bodies were cooled by the fine southerly trade-wind, and our senses refreshed by the sight of a green and thriving vegetation. The houses are irregularly scattered over a flat space of ground, which is cultivated with sweet potatoes and bananas. It will not easily be imagined how pleasant the

* Dampier's Voyage, vol. i., p. 101.

sight of black mud was to us, after having been so long accustomed to the parched soil of Peru and Chile.

The inhabitants, although complaining of poverty, gain, without much trouble, the means of subsistence from the fertile soil. In the woods there are many wild pigs and goats, but the main article of animal food is derived from the tortoise. Their numbers in this island have of course been greatly reduced, but the people yet reckon on two days' hunting supplying food for the rest of the week. It is said that formerly single vessels have taken away as many as seven hundred of these animals, and that the ship's company of a frigate some years since brought down two hundred to the beach in one day.

We staid at this island four days, during which time I collected many plants and birds. One morning I ascended the highest hill, which has an altitude of nearly 1800 feet. The summit consists of a broken-down crater, thickly clothed with coarse grass and brushwood. Even in this one island, I counted thirty-nine hills, each of which was terminated by a more or less perfect circular depression.

September 29th.—We doubled the south-west extremity of Albermarle Island, and the next day were nearly becalmed between it and Narborough Island. Both are covered with immense streams of black naked lava; which, having either flowed over the rims of the great caldrons, or having burst forth from the smaller orifices on the flanks, have in their descent spread over miles of the sea-coast. On both of these islands eruptions are known occasionally to take place; and in Albermarle we saw a small jet of smoke curling from the summit of one of the more lofty craters. In the evening we anchored in Bank's Cove, in Albermarle Island.

When morning came, we found that the harbour in which we were at anchor was formed by a broken-down crater, composed of volcanic sandstone. After breakfast I went out walking. To the southward of this first crater, there was another of similar composition, and beautifully

symmetrical. It was elliptic in form; the longer axis being less than a mile, and its depth about 500 feet. The bottom was occupied by a shallow lake, and in its centre a tiny crater formed an islet. The day was overpoweringly hot, and the lake looked clear and blue. I hurried down the cindery slope, and choked with dust eagerly tasted the water—but to my sorrow I found it salt as brine.

The rocks on the coast abounded with great black lizards, between three and four feet long; and on the hills, another species was equally common. We saw several of the latter, some clumsily running out of our way, and others shuffling into their burrows. I shall presently describe in more detail the habits of both these reptiles.

October 3d.—We sailed round the northern end of Albermarle Island. Nearly the whole of this side is covered with recent streams of dark-coloured lavas, and is studded with craters. I should think it would be difficult to find in any other part of the world, an island situated within the tropics, and of such considerable size (namely 75 miles long), so sterile and incapable of supporting life.

On the 8th we reached James Island.* Captain FitzRoy put Mr. Bynoe, myself, and three others on shore, leaving with us a tent and provisions, to wait there till the vessel returned from watering. This was an admirable plan for the collections, as we had an entire week of hard work. We found here a party of Spaniards, who had been sent from Charles Island to dry fish, and to salt tortoise-meat.

At the distance of about six miles, and at the height of nearly 2000 feet, the Spaniards had erected a hovel in which two men lived, who were employed in catching tortoises, whilst the others were fishing on the coast. I paid this party two visits, and slept there one night. In the same manner as in the other islands, the lower region is covered by nearly leafless bushes: but here many of them grow to the size of

* Both Charles and James Islands take their names from the Stuarts. See Cowley's Voyage in 1684.

trees. I measured several which were two feet in diameter, and some even two feet nine inches. The upper region being kept damp, from the moisture of the condensed clouds, supports a green and flourishing vegetation. So damp was the ground, that there were large beds of a coarse carex, in which great numbers of a very small water-rail lived and bred. While staying in this upper region, we lived entirely upon tortoise-meat. The breastplate roasted (as the Gauchos do *carne con cuero*), with the flesh attached to it, is very good; and the young tortoises make excellent soup; but otherwise the meat to my taste is very indifferent.

During another day we accompanied a party of the Spaniards in their whale-boat to a salina, or lake from which salt is procured. After landing, we had a very rough walk over a rugged field of recent lava, which has almost surrounded a sandstone crater, at the bottom of which the salt-lake is situated. The water was only three or four inches deep, and rested on a layer of beautifully crystallized white salt. The lake was quite circular, and fringed with a border of brightly green succulent plants: the precipitous walls of the crater were also clothed with wood, so that the scene was both picturesque and curious. A few years since, the sailors belonging to a sealing-vessel murdered their captain in this quiet spot; and we saw his skull lying among the bushes.

During the greater part of our week on shore, the sky was cloudless, and if the trade-wind failed for an hour, the heat became very oppressive. On two days, the thermometer within the tent stood for some hours at 93°; but in the open air, in the wind and sun, at only 85°. The sand was extremely hot; the thermometer placed in some of a brown colour immediately rose to 137°, and how much higher it would have risen, I do not know, for it was not graduated above that number. The *black* sand felt much hotter, so that even in thick boots it was disagreeable, on this account, to walk over it.

I will now offer a few general observations on the natural history of these islands. I endeavoured to make as nearly a perfect collection in every branch as time permitted. The plants have not yet been examined, but Professor Henslow, who has kindly undertaken the description of them, informs me that there are probably many new species, and perhaps even some new genera. They all have an extremely weedy character, and it would scarcely have been supposed, that they had grown at an inconsiderable elevation directly under the equator. In the lower and sterile parts, the bush, which from its minute brown leaves chiefly gives the leafless appearance to the brushwood, is one of the Euphorbiaceæ. In the same region an acacia and a cactus (*Opuntia Galapageia**), with large oval compressed articulations, springing from a cylindrical stem, are in some parts common. These are the only trees which in that part afford any shade. Near the summits of the different islands, the vegetation has a very different character; ferns and coarse grasses are abundant; and the commonest tree is one of the Compositæ. Tree-ferns are not present. One of the most singular characters of the Flora, considering the position of this archipelago, is the absence of every member of the palm family. Cocos Island, on the other hand, which is the nearest point of land, takes its name from the great number of cocoa-nut trees on it. From the presence of the Opuntias and some other plants, the vegetation partakes more of the character of that of America than of any other country.

Of mammalia a large kind of mouse forms a well-marked species. From its large thin ears, and other characters, it approaches in form a section of the genus, which is confined to the sterile regions of South America. There is also a rat which Mr. Waterhouse believes is probably distinct from the English kind; but I cannot help suspecting that it is only the same altered by the peculiar conditions of its new country.

* Magazine of Zoology and Botany, vol. i., p. 466.

In my collections from these islands, Mr. Gould considers that there are twenty-six different species of land birds. With the exception of one, all probably are undescribed kinds, which inhabit this archipelago, and no other part of the world. Among the waders and waterfowl it is more difficult, without detailed comparison, to say what are new. But a water-sail which lives near the summits of the mountains, is undescribed, as perhaps is a Totanus and a heron. The only kind of gull which is found among these islands, is also new; when the wandering habits of this genus are considered, this is a very remarkable circumstance. The species most closely allied to it, comes from the Strait of Magellan. Of the other aquatic birds, the species appear the same with well-known American birds.

The general character of the plumage of these birds is extremely plain, and like the Flora possesses little beauty. Although the species are thus peculiar to the archipelago, yet nearly all in their general structure, habits, colour of feathers, and even tone of voice, are strictly American. The following brief list will give an idea of their kinds. 1st. A buzzard, having many of the characters of Polyborus or Caracara; and in its habits not to be distinguished from that peculiar South American genus; 2d. Two owls; 3d. Three species of tyrant-flycatchers — a form strictly American. One of these appears identical with a common kind (*Muscicapa coronata?* Lath.), which has a very wide range, from La Plata throughout Brazil to Mexico; 4th. A sylvicola, an American form, and especially common in the northern division of the continent; 5th. Three species of mocking-birds, a genus common to both Americas; 6th. A finch, with a stiff tail and a long claw to its hinder toe, closely allied to a North American genus; 7th. A swallow belonging to the American division of that genus; 8th. A dove, like, but distinct from, the Chilian species; 9th. A group of finches, of which Mr. Gould considers there are thirteen species; and these he has distributed into four new sub-genera. These birds are the most singular of

any in the archipelago. They all agree in many points; namely, in a peculiar structure of their bill, short tails, general form, and in their plumage. The females are gray or brown, but the old cocks jet-black. All the species, excepting two, feed in flocks on the ground, and have very similar habits. It is very remarkable that a nearly perfect gradation of structure in this one group can be traced in the form of the beak, from one exceeding in dimensions that of the largest gros-beak, to another differing but little from that of a warbler. Of the aquatic birds I have already remarked that some are peculiar to these islands, and some common to North and South America.

We will now turn to the order of reptiles, which forms, perhaps, the most striking feature in the zoology of these islands. The species are not numerous, but the number of individuals of each kind, is extraordinarily great. There is one kind both of the turtle and tortoise; of lizards four; and of snakes about the same number.

I will first describe the habits of the tortoise (*Testudo Indicus*) which has been so frequently alluded to. These animals are found, I believe, in all the islands of the Archipelago; certainly in the greater number. They frequent in preference the high damp parts, but likewise inhabit the lower and arid districts. I have already mentioned* proofs, from the numbers which have been taken in a single day, how very numerous they must be. Some individuals grow to an immense size: Mr. Lawson, an Englishman, who had at the time of our visit charge of the colony, told us that he had seen several so large, that it required six or eight men to lift them from the ground; and that some had afforded as much as two hundred pounds of meat. The old males are the largest, the females rarely growing to so great a size. The male can readily be distinguished from the female by the

* Dampier says, "The land-turtles are here so numerous, that five or six hundred men might subsist on them for several months without any other sort of provisions. They are so extraordinarily large and fat, and so sweet, that no pullet eats more pleasantly."—Vol. i., p. 110.

greater length of its tail. The tortoises which live on those islands where there is no water, or in the lower and arid parts of the others, chiefly feed on the succulent cactus. Those which frequent the higher and damp regions, eat the leaves of various trees, a kind of berry (called guayavita) which is acid and austere, and likewise a pale green filamentous lichen, that hangs in tresses from the boughs of the trees.

The tortoise is very fond of water, drinking large quantities, and wallowing in the mud. The larger islands alone possess springs, and these are always situated towards the central parts, and at a considerable elevation. The tortoises, therefore, which frequent the lower districts, when thirsty, are obliged to travel from a long distance. Hence broad and well-beaten paths radiate off in every direction from the wells even down to the sea-coast; and the Spaniards by following them up, first discovered the watering-places. When I landed at Chatham Island, I could not imagine what animal travelled so methodically along the well-chosen tracks. Near the springs it was a curious spectacle to behold many of these great monsters; one set eagerly travelling onwards with outstretched necks, and another set returning, after having drunk their fill. When the tortoise arrives at the spring, quite regardless of any spectator, it buries its head in the water above its eyes, and greedily swallows great mouthfuls, at the rate of about ten in a minute. The inhabitants say each animal stays three or four days in the neighbourhood of the water, and then returns to the lower country; but they differed in their accounts respecting the frequency of these visits. The animal probably regulates them according to the nature of the food which it has consumed. It is, however, certain, that tortoises can subsist even on those islands where there is no other water, than what falls during a few rainy days in the year.

I believe it is well ascertained, that the bladder of the frog

acts as a reservoir for the moisture necessary to its existence: such seems to be the case with the tortoise. For some time after a visit to the springs, the urinary bladder of these animals is distended with fluid, which is said gradually to decrease in volume, and to become less pure. The inhabitants, when walking in the lower district, and overcome with thirst, often take advantage of this circumstance, by killing a tortoise, and if the bladder is full, drinking its contents. In one I saw killed, the fluid was quite limpid, and had only a *very slightly* bitter taste. The inhabitants, however, always drink first the water in the pericardium, which is described as being best.

The tortoises, when moving towards any definite point, travel by night and day, and arrive at their journey's end much sooner than would be expected. The inhabitants, from observations on marked individuals, consider that they can move a distance of about eight miles in two or three days. One large tortoise, which I watched, I found walked at the rate of sixty yards in ten minutes, that is 360 in the hour, or four miles a day,—allowing also a little time for it to eat on the road.

During the breeding season, when the male and female are together, the male utters a hoarse roar or bellowing, which it is said, can be heard at the distance of more than a hundred yards. The female never uses her voice, and the male only at such times; so that when the people hear this noise, they know the two are together. They were at this time (October) laying their eggs. The female, where the soil is sandy, deposits them together, and covers them up with sand; but where the ground is rocky she drops them indiscriminately in any hollow. Mr. Bynoe found seven placed in a line in a fissure. The egg is white and spherical; one which I measured was seven inches and three-eighths in circumference. The young animals, as soon as they are hatched, fall a prey in great numbers to the buzzard, with the habits of the Caracara. The old ones seem generally

to die from accidents, as from falling down precipices. At least several of the inhabitants told me, they had never found one dead without some such apparent cause.

The inhabitants believe that these animals are absolutely deaf; certainly they do not overhear a person walking close behind them. I was always amused, when overtaking one of these great monsters as it was quietly pacing along, to see how suddenly, the instant I passed, it would draw in its head and legs, and uttering a deep hiss fall to the ground with a heavy sound, as if struck dead. I frequently got on their backs, and then, upon giving a few raps on the hinder part of the shell, they would rise up and walk away;—but I found it very difficult to keep my balance.

The flesh of this animal is largely employed, both fresh and salted; and a beautifully clear oil is prepared from the fat. When a tortoise is caught, the man makes a slit in the skin near its tail, so as to see inside its body, whether the fat under the dorsal plate is thick. If it is not, the animal is liberated; and it is said to recover soon from this strange operation. In order to secure the tortoises, it is not sufficient to turn them like turtle, for they are often able to regain their upright position.

It was confidently asserted, that the tortoises coming from different islands in the archipelago were slightly different in form; and that in certain islands they attained a larger average size than in others. Mr. Lawson maintained that he could at once tell from which island any one was brought. Unfortunately, the specimens which came home in the Beagle were too small to institute any certain comparison. This tortoise, which goes by the name of *Testudo Indicus*, is at present found in many parts of the world. It is the opinion of Mr. Bell, and some others who have studied reptiles, that it is not improbable that they all originally came from this archipelago. When it is known how long these islands have been frequented by the bucaniers, and that they constantly took away numbers of these animals alive, it seems very probable that they should have distributed them in

different parts of the world. If this tortoise does not originally come from these islands, it is a remarkable anomaly; inasmuch as nearly all the other land inhabitants seem to have had their birthplace here.

Of lizards there are four or five species; two probably belong to the South American genus Leiocephalus, and two to Amblyrhyncus. This remarkable genus was characterized by Mr. Bell,* from a stuffed specimen sent from Mexico, but which I conceive there can be little doubt originally came through some whaling ship from these islands. The two species agree pretty closely in general appearance; but one is aquatic and the other terrestrial in its habits. Mr. Bell thus concludes his description of *Amb. cristatus:* "On a comparison of this animal with the true Iguanas, the most striking and important discrepancy is in the form of the head. Instead of the long, pointed, narrow muzzle of those species, we have here a short, obtusely truncated head, not so long as it is broad, the mouth consequently only capable of being opened to a very short space. These circumstances, with the shortness and equality of the toes, and the strength and curvature of the claws, evidently indicate some striking peculiarity in its food and general habits, on which, however, in the absence of all certain information, I shall abstain from offering any conjecture." The following account of these two lizards, will, I think, show with what judgment Mr. Bell foresaw a variation in habit, accompanying change in structure.

First for the aquatic kind (*Amb. cristatus*). This lizard is extremely common on all the islands throughout the Archipelago. It lives exclusively on the rocky sea-beaches, and is never found, at least I never saw one, even ten yards inshore. It is a hideous-looking creature, of a dirty black colour, stupid and sluggish in its movements. The usual length of a full-grown one is about a yard, but there are some even four feet long: I have seen a large one which

* Zoological Journal, July, 1835.

weighed twenty pounds. On the island of Albemarle they seem to grow to a greater size than on any other. These lizards were occasionally seen some hundred yards from the shore swimming about; and Captain Collnett, in his Voyage, says, "they go out to sea in shoals to fish." With respect to the object, I believe he is mistaken; but the fact stated on such good authority cannot be doubted. When in the water the animal swims with perfect ease and quickness, by a serpentine movement of its body and flattened tail,—the legs, during this time, being motionless and closely collapsed on its sides. A seaman on board sank one, with a heavy weight attached to it, thinking thus to kill it directly; but when an hour afterwards he drew up the line, the lizard was quite active. Their limbs and strong claws are admirably adapted for crawling over the rugged and fissured masses of lava, which every where form the coast. In such situations, a group of six or seven of these hideous reptiles may oftentimes be seen on the black rocks, a few feet above the surf, basking in the sun with outstretched legs.

I opened the stomach of several, and in each case found it largely distended with minced sea-weed, of that kind which grows in thin foliaceous expansions of a bright green or dull red colour. I do not recollect having observed this sea-weed in any quantity on the tidal rocks; and I have reason to believe it grows at the bottom of the sea, at some little distance from the coast. If such is the case, the object of these animals occasionally going out to sea is explained. The stomach contained nothing but the sea-weed. Mr. Bynoe, however, found a piece of a crab in one; but this might have got in accidentally, in the same manner as I have seen a caterpillar, in the midst of some lichen, in the paunch of a tortoise. The intestines were large, as in other herbivorous animals.

The nature of this lizard's food, as well as the structure of its tail, and the certain fact of its having been seen volun-

tarily swimming out at sea, absolutely prove its aquatic habits; yet there is in this respect one strange anomaly; namely, that when frightened it will not enter the water. From this cause, it is easy to drive these lizards down to any little point overhanging the sea, where they will sooner allow a person to catch hold of their tail than jump into the water. They do not seem to have any notion of biting; but when much frightened they squirt a drop of fluid from each nostril. One day I carried one to a deep pool left by the retiring tide, and threw it in several times as far as I was able. It invariably returned in a direct line to the spot where I stood. It swam near the bottom, with a very graceful and rapid movement, and occasionally aided itself over the uneven ground with its feet. As soon as it arrived near the margin, but still being under water, it either tried to conceal itself in the tufts of sea-weed, or it entered some crevice. As soon as it thought the danger was past, it crawled out on the dry rocks, and shuffled away as quickly as it could. I several times caught this same lizard, by driving it down to a point, and though possessed of such perfect powers of diving and swimming, nothing would induce it to enter the water; and as often as I threw it in, it returned in the manner above described. Perhaps this singular piece of apparent stupidity may be accounted for by the circumstance, that this reptile has no enemy whatever on shore, whereas at sea it must often fall a prey to the numerous sharks. Hence, probably urged by a fixed and hereditary instinct that the shore is its place of safety, whatever the emergency may be, it there takes refuge.

During our visit (in October) I saw extremely few small individuals of this species, and none I should think under a year old. From this circumstance it seems probable that the breeding season had not commenced. I asked several of the inhabitants if they knew where it laid its eggs: they said, that although well acquainted with the eggs of the other kind, they had not the least knowledge of the

manner in which this species is propagated;—a fact, considering how common an animal this lizard is, not a little extraordinary.

We will now turn to the terrestrial species (*Amb. subcristatus* of Gray).* This species, differently from the last, is confined to the central islands of the Archipelago, namely to Albemarle, James, Barrington, and Indefatigable. To the southward, in Charles, Hood, and Chatham islands, and to the northward, in Towers, Bindloes, and Abington, I neither saw nor heard of any. It would appear as if this species had been created in the centre of the Archipelago, and thence had been dispersed only to a certain distance.

In the central islands they inhabit both the higher and damp, as well as the lower and sterile parts; but in the latter they are much the most numerous. I cannot give a more forcible proof of their numbers, than by stating, that when we were left at James Island, we could not for some time find a spot free from their burrows, on which to pitch our tent. These lizards, like their brothers the sea-kind, are ugly animals; and from their low facial angle have a singularly stupid appearance. In size perhaps they are a little inferior to the latter, but several of them weighed between ten and fifteen pounds each. The colour of their belly, front legs, and head (excepting the crown which is nearly white), is a dirty yellowish-orange: the back is a brownish-red, which in the younger specimens is darker. In their movements they are lazy and half torpid. When not frightened, they slowly crawl along with their tails and bellies dragging on the ground. They often stop, and doze for a minute with closed eyes, and hind legs spread out on the parched soil.

* Briefly characterized by Mr. Gray in the Zoological Miscellany, from a specimen badly stuffed; from which cause one of its most important characters (the rounded tail, compared to the flattened one of the aquatic kind) was overlooked. Captain FitzRoy has presented some fine specimens of both species to the British Museum. I cannot omit here returning my thanks to Mr. Gray, for the kind manner in which he has afforded me every facility as often as I have visited the British Museum.

They inhabit burrows; which they sometimes excavate between fragments of lava, but more generally on level patches of the soft volcanic sandstone. The holes do not appear to be very deep, and they enter the ground at a small angle; so that when walking over these lizard *warrens*, the soil is constantly giving way, much to the annoyance of the tired walker. This animal when excavating its burrow, alternately works the opposite sides of its body. One front leg for a short time scratches up the soil, and throws it towards the hind foot, which is well placed so as to heave it beyond the mouth of the hole. This side of the body being tired, the other takes up the task, and so on alternately. I watched one for a long time, till half its body was buried; I then walked up and pulled it by the tail; at this it was greatly astonished, and soon shuffled up to see what was the matter; and then stared me in the face, as much as to say, "What made you pull my tail?"

They feed by day, and do not wander far from their burrows; and if frightened they rush to them with a most awkward gait. Except when running down hill, they cannot move very fast; which appears chiefly owing to the lateral position of their legs.

They are not at all timorous: when attentively watching any one, they curl their tails, and raising themselves on their front legs, nod their heads vertically, with a quick movement, and try to look very fierce: but in reality they are not at all so; if one just stamps the ground, down go their tails, and off they shuffle as quickly as they can. I have frequently observed small muscivorous lizards, when watching any thing, nod their heads in precisely the same manner; but I do not at all know for what purpose. If this Amblyrhyncus is held, and plagued with a stick, it will bite it very severely; but I caught many by the tail, and they never tried to bite me. If two are placed on the ground and held together, they will fight and bite each other till blood is drawn.

The individuals (and they are the greater number) which inhabit the lower country, can scarcely taste a drop of water

throughout the year; but they consume much of the succulent cactus, the branches of which are occasionally broken off by the wind. I have sometimes thrown a piece to two or three when together; and it was amusing enough to see each trying to sieze and carry it away in its mouth, like so many hungry dogs with a bone. They eat very deliberately, but do not chew their food. The little birds are aware how harmless these creatures are: I have seen one of the thick-billed finches picking at one end of a piece of cactus (which is in request among all the animals of the lower region), whilst a lizard was eating at the other; and afterwards the little bird with the utmost indifference hopped on the back of the reptile.

I opened the stomachs of several, and found them full of vegetable fibres, and leaves of different trees, especially of a species of acacia. In the upper region they live chiefly on the acid and astringent berries of the guayavita, under which trees I have seen these lizards and the huge tortoises feeding together. To obtain the acacia-leaves, they crawl up the low stunted trees; and it is not uncommon to see one or a pair quietly browsing, whilst seated on a branch several feet above the ground.

The meat of these animals when cooked is white, and by those whose stomachs rise above all prejudices, it is relished as very good food. Humboldt has remarked that in intertropical South America, all lizards which inhabit *dry* regions are esteemed delicacies for the table. The inhabitants say, that those inhabiting the damp region drink water, but that the others do not travel up for it from the sterile country like the tortoises. At the time of our visit, the females had within their bodies numerous large elongated eggs. These they lay in their burrows, and the inhabitants seek them for food.

These two species of Amblyrhyncus agree, as I have already stated, in general structure, and in many of their habits. Neither have that rapid movement, so characteristic of true Lacerta and Iguana. They are both herbivorous,

although the kind of vegetation consumed in each case is so very different. Mr. Bell has given the name to the genus from the shortness of the snout: indeed, the form of the mouth may almost be compared to that of the tortoise. One is tempted to suppose this is an adaptation to their herbivorous appetites. It is very interesting thus to find a well-characterized genus, having its aquatic and terrestrial species, belonging to so confined a portion of the world. The former species is by far the most remarkable, because it is the only existing Saurian, which can properly be said to be a maritime animal. I should perhaps have mentioned earlier, that in the whole archipelago, there is only one rill of fresh water that reaches the coast; yet these reptiles frequent the sea-beaches, and no other parts in all the islands. Moreover, there is no existing lizard, as far as I am aware, excepting this Amblyrhyncus, that feeds exclusively on aquatic productions. If, however, we refer to epochs long past, we shall find such habits common to several gigantic animals of the Saurian race.

To conclude with the order of reptiles. Of snakes there are several species, but all harmless. Of toads and frogs there are none. I was surprised at this, considering how well the temperate and damp woods in the elevated parts appeared adapted for their habits. It recalled to my mind the singular statement made by Bory St. Vincent,* namely, that none of this family are to be found on the volcanic islands in the great oceans. There certainly appears to be some foundation for this observation; which is the more remarkable, when compared with the case of lizards, which are generally among the earliest colonists of the smallest islet. It may be asked, whether this is not owing to the different facilities of transport through salt-water, of the eggs of the latter protected by a calcareous coat, and of the slimy spawn of the former?

As I at first observed, these islands are not so remarkable

* Voyage aux quatre Iles d'Afrique.

for the number of species of reptiles, as for that of individuals; when we remember the well-beaten paths made by the many hundred great tortoises—the warrens of the terrestrial Amblyrhyncus—and the groups of the aquatic species basking on the coast-rocks—we must admit that there is no other quarter of the world, where this order replaces the herbivorous mammalia in so extraordinary a manner. It is worthy of observation by the geologist (who will probably refer back in his mind to the secondary periods, when the Saurians were developed with dimensions, which at the present day can be compared only to the cetaceous mammalia), that this archipelago, instead of possessing a humid climate and rank vegetation, cannot be considered otherwise than extremely arid, and for an equatorial region, remarkably temperate.

To finish with the zoology: I took great pains in collecting the insects, but I was surprised to find, even in the high and damp region, how exceedingly few they were in number. The forests of Tierra del Fuego are certainly much more barren; but with that exception I never collected in so poor a country. In the lower and sterile land I took seven species of Heteromera, and a few other insects; but in the fine thriving woods towards the centre of the islands, although I perseveringly swept under the bushes during all kinds of weather, I obtained only a few minute Diptera and Hymenoptera. Owing to this scarcity of insects, nearly all the birds live in the lower country; and the part which any one would have thought much the most favourable for them, is frequented only by a few of the small tyrant-flycatchers. I do not believe a single bird, excepting the water-rail, is confined to the damp region. Mr. Waterhouse informs me that nearly all the insects belong to European forms, and that they do not by any means possess an equatorial character. I did not take a single one of large size, or of bright colours. This last observation applies equally to the birds and flowers. It is worthy of remark, that the only land-bird with bright colours, is that species of tyrant-flycatcher, which

seems to be a wanderer from the continent. Of shells, there are a considerable number of land kinds, all of which, I believe are confined to this archipelago. Even of marine species, a large proportion were not known, before the collection made by Mr. Cuming on these islands was brought to England.

I will not here attempt to come to any definite conclusions, as the species have not been accurately examined; but we may infer, that, with the exception of a few wanderers, the organic beings found on this archipelago are peculiar to it; and yet that their general form strongly partakes of an American character. It would be impossible for any one accustomed to the birds of Chile and La Plata to be placed on these islands, and not to feel convinced that he was, as far as the organic world was concerned, on American ground. This similarity in type, between distant islands and continents, while the species are distinct, has scarcely been sufficiently noticed. The circumstance would be explained, according to the views of some authors, by saying that the creative power had acted according to the same law over a wide area.

It has been mentioned, that the inhabitants can distinguish the tortoises, according to the islands whence they are brought. I was also informed that many of the islands possess trees and plants which do not occur on the others. For instance the berry-bearing tree, called Guyavita, which is common on James Island, certainly is not found on Charles Island, though appearing equally well fitted for it. Unfortunately, I was not aware of these facts till my collection was nearly completed: it never occurred to me, that the productions of islands only a few miles apart, and placed under the same physical conditions, would be dissimilar. I therefore did not attempt to make a series of specimens from the separate islands. It is the fate of every voyager, when he has just discovered what object in any place is more particularly worthy of his attention, to be hurried from it. In the case of the mocking-bird, I ascertained (and have

brought home the specimens) that one species (*Orpheus trifasciatus*, Gould) is exclusively found in Charles Island; a second (*O. parvulus*) on Albemarle Island; and a third (*O. melanotus*) common to James and Chatham Islands. The two last species are closely allied, but the first would be considered by every naturalist as quite distinct. I examined many specimens in the different islands, and in each the respective kind was *alone* present. These birds agree in general plumage, structure, and habits; so that the different species replace each other in the economy of the different islands. These species are not characterized by the markings on the plumage alone, but likewise by the size and form of the bill, and other differences. I have stated, that in the thirteen species of ground-finches, a nearly perfect gradation may be traced, from a beak extraordinarily thick, to one so fine, that it may be compared to that of a warbler. I very much suspect, that certain members of the series are confined to different islands; therefore, if the collection had been made on any *one* island, it would not have presented so perfect a gradation. It is clear, that if several islands have each their peculiar species of the same genera, when these are placed together, they will have a wide range of character. But there is not space in this work, to enter on this curious subject.

Before concluding my account of the zoology of these islands, I must describe more in detail the tameness of the birds. This disposition is common to all the terrestrial species; namely, to the mocking-birds, the finches, sylvicolæ, tyrant-flycatchers, doves, and hawks. There is not one which will not approach sufficiently near to be killed with a switch, and sometimes, as I have myself tried, with a cap or hat. A gun is here almost superfluous; for with the muzzle of one I pushed a hawk off the branch of a tree. One day a mocking-bird alighted on the edge of a pitcher (made of the shell of a tortoise), which I held in my hand whilst lying down. It began very quietly to sip the water, and allowed me to lift it with the vessel from the ground.

I often tried, and very nearly succeeded, in catching these birds by their legs. Formerly the birds appear to have been even tamer than at present. Cowley* (in the year 1684) says that the "Turtle-doves were so tame that they would often alight upon our hats and arms, so as that we could take them alive: they not fearing man, until such time as some of our company did fire at them, whereby they were rendered more shy." Dampier† (in the same year) also says that a man in a morning's walk might kill six or seven dozen of these birds. At present, although certainly very tame, they do not alight on people's arms; nor do they suffer themselves to be killed in such numbers. It is surprising that the change has not been greater; for these islands during the last hundred and fifty years, have been frequently visited by bucaniers and whalers; and the sailors, wandering through the woods in search of tortoises, always take delight in knocking down the little birds.

These birds, although much persecuted, do not become wild in a short time: in Charles Island, which had then been colonized about six years, I saw a boy sitting by a well with a switch in his hand, with which he killed the doves and finches as they came to drink. He had already procured a little heap of them for his dinner; and he said he had constantly been in the habit of waiting there for the same purpose. We must conclude that the birds, not having as yet learnt that man is a more dangerous animal than the tortoise, or the amblyrhyncus, disregard us, in the same manner as magpies in England do the cows and horses grazing in the fields.

The Falkland Islands offer a second instance of this disposition among its birds. The extraordinary tameness of the dark-coloured Furnarius has been remarked by Pernety, Lesson, and other voyagers. It is not, however, peculiar to that bird: the Caracara, snipe, upland and lowland

* Cowley's Voyage, p. 10, in Dampier's Collection of Voyages.

† Dampier's Voyage, vol. i., p. 103.

goose, thrush, Emberiza, and even some true hawks, are all more or less tame. Both hawks and foxes are present; and as the birds are so tame, we may infer that the absence of all rapacious animals at the Galapagos, is not the cause of their tameness there. The geese at the Falklands, by the precaution they take in building on the islets, show that they are aware of their danger from the foxes; but they are not by this rendered wild towards man. This tameness of the birds, especially the waterfowl, is strongly contrasted with the habits of the same species in Tierra del Fuego, where for ages past they have been persecuted by the wild inhabitants. In the Falklands, the sportsman may sometimes kill more of the upland geese in one day, than he is able to carry home; whereas in Tierra del Fuego, it is nearly as difficult to kill one, as it is in England of the common wild species.

In the time of Pernety* (1763), all the birds appear to have been much tamer than at present. Pernety states that the Furnarius would almost perch on his finger; and that with a wand he killed ten in half an hour. At that period, the birds must have been about as tame as they now are at the Galapagos. They appear to have learnt caution more quickly at the Falklands than at the latter place, and they have had proportionate means of experience; for besides frequent visits from vessels, the islands have been at intervals colonized during the whole period.

Even formerly, when all the birds were so tame, by Pernety's account it was impossible to kill the black-necked swan. It is rather an interesting fact, that this is a bird of passage, and therefore brings with it the wisdom learnt in foreign countries.

I have not met with any account of the *land* birds being so tame, in any other quarter of the world, as at the Galapagos and Falkland Islands. And it may be observed that of the few archipelagoes of any size, which when discovered were

* Pernety, Voyage aux Iles Malouines, vol. ii., p. 20.

uninhabited by man, these two are among the most important. From the foregoing statements we may, I think, conclude; first, that the wildness of birds with regard to man, is a particular instinct directed against *him*, and not dependent on any general degree of caution arising from other sources of danger; secondly, that it is not acquired by them in a short time, even when much persecuted; but that in the course of successive generations it becomes hereditary. With domesticated animals we are accustomed to see instincts becoming hereditary; but with those in a state of nature, it is more rare to discover instances of such acquired knowledge. In regard to the wildness of birds towards men, there is no other way of accounting for it. Few young birds in England have been injured by man, yet all are afraid of him: many individuals, on the other hand, both at the Galapagos and at the Falklands, have been injured, but yet have not learned that salutary dread. We may infer from these facts, what havoc the introduction of any new beast of prey must cause in a country, before the instincts of the aborigines become adapted to the stranger's craft or power.

CHAPTER XX.

Tahiti—Aspect—Vegetation on the slope of the mountains—View of Eimeo—Excursion in the interior—Profound ravines—Succession of waterfalls—Number of wild useful plants—Temperance of inhabitants—Their moral state—Parliament convened—New Zealand—Bay of islands—Hippahs—Absence of all government—Excursion to Waimate—Missionary establishment—English weeds now run wild—Waiomio—Funeral service—Sail from New Zealand.

TAHITI AND NEW ZEALAND.

October 20th.—The survey of the Galapagos Archipelago being concluded, a course was steered towards Tahiti; and we commenced our long passage of 3200 miles. In the course of a few days we sailed out of the gloomy and clouded region, which extends during the winter far from the coast of South America. We then enjoyed bright and clear weather, while running pleasantly along at the rate of 150 or 160 miles a day before a steady trade-wind. The temperature in this more central part of the Pacific, is higher than near the American shore. The thermometer in the poop cabin, both by night and day, ranged between 80° and 83°, which to my feelings was quite delightful; but with one degree higher, the effect became oppressive. We passed through the Dangerous or Low Archipelago, and saw several of those most curious rings of land, just rising above the edge of the water, which have been called Lagoon Islands. A long and brilliantly-white beach is capped by a margin of green vegetation; and this strip appears on both hands rapidly to narrow away in the distance, and then sinks beneath the horizon. From the mast-head a wide expanse of smooth water can be seen within the annular margin of land. These low islands bear no proportion to the vast ocean out of which they abruptly rise; and it seems wonderful, that such weak in-

truders are not overwhelmed, by the all-powerful and never-tiring waves of that great sea, miscalled the Pacific.

November 15th.—At daylight, Tahiti, an island which must for ever remain as classical to the voyager in the South Sea, was in view. At this distance the appearance was not very inviting. The luxuriant vegetation of the lower parts was not discernible, and as the clouds rolled past, the wildest and most precipitous peaks showed themselves towards the centre of the island. As soon as we came to an anchor in Matavai Bay, we were surrounded by canoes. This was our Sunday, but the Monday of Tahiti: if the case had been reversed, we should not have received a single visit; for the injunction not to launch a canoe on the sabbath is rigidly obeyed. After dinner we landed to enjoy all the delights of the first impressions produced by a new country, and that country the charming Tahiti. A crowd of men, women, and children, was collected on the memorable point Venus, ready to receive us with laughing, merry faces. They marshalled us towards the house of Mr. Wilson, the missionary of the district, who met us on the road, and gave us a very friendly reception. After sitting a short time in his house, we separated to walk about, but returned there in the evening.

The land capable of cultivation is scarcely in any part more than a fringe of low alluvial soil, accumulated round the base of the mountains, and protected from the waves of the sea by a coral reef, which encircles at a distance the entire line of coast. The reef is broken in several parts so that ships can pass through, and the lake of smooth water within thus affords a safe harbour, as well as a channel for the native canoes. The low land which comes down to the beach of coral sand, is covered by the most beautiful productions of the intertropical regions. In the midst of bananas, orange, cocoa-nut, and breadfruit trees, spots are cleared where yams, sweet potatoes, sugar-cane, and pine-apples, are cultivated. Even the brushwood is a fruit-tree, namely, the guava, which from its abundance is as noxious

as a weed. In Brazil I have often admired the contrast of varied beauty in the banana, palm, and orange tree: here we have in addition the bread-fruit, conspicuous from its large, glossy, and deeply digitated leaf. It is admirable to behold groves of a tree, sending forth its branches with the force of an English oak, loaded with large and most nutritious fruit. However little on most occasions utility explains the delight received from any fine prospect, in this case it cannot fail to enter as an element in the feeling. The little winding paths, cool from the surrounding shade, led to the scattered houses; and the owners of these every where gave us a cheerful and most hospitable reception.

I was pleased with nothing so much as with the inhabitants. There is a mildness in the expression of their countenances, which at once banishes the idea of a savage; and an intelligence, which shows they are advancing in civilization. Their dress is as yet incongruous; no settled costume having taken the place of the ancient one. But even in its present state, it is far from being so ridiculous as it has been described by travellers of a few years' standing. Those who can afford it wear a white shirt, and sometimes a jacket, with a wrapper of coloured cotton round their middles; thus making a short petticoat, like the chilipa of the Gauchos. This dress appears so general with the chiefs, that it will probably become the settled fashion. No one, even to the queen, wears shoes or stockings; and only the chiefs have a straw hat on their heads. The common people, when working, keep the upper part of their bodies uncovered; and it is then that the Tahitians are seen to advantage. They are very tall, broad-shouldered, athletic, and with well-proportioned limbs. It has been somewhere remarked, that it requires little habit to make a darker tint of the skin more pleasing and natural, even to the eye of an European, than his own colour. To see a white man bathing by the side of a Tahitian, was like comparing a plant bleached by the gardener's art, with one growing in the open fields. Most of the men are tattooed; and the orna-

ments follow the curvature of the body so gracefully, that they have a very pleasing and elegant effect. One common figure, varying only in its detail, branches somewhat like a tuft of palm-leaves* from the line of the backbone, and curls round each side. The simile may be a fanciful one, but I thought the body of a man thus ornamented, was like the trunk of a noble tree embraced by a delicate creeper.

Many of the older people had their feet covered with small figures, placed in order so as to resemble a sock. This fashion, however, is partly gone by, and has been succeeded by others. Here, although each man must for ever abide by the whim which reigned in his early days, yet fashion is far from immutable. An old man has thus his age for ever stamped on his body, and he cannot assume the airs of a young dandy. The women are also tattooed in the same manner as the men, and very commonly on their fingers. An unbecoming fashion in one respect is now almost universal: it is that of cutting the hair, or rather shaving it, from the upper part of the head, in a circular form, so as to leave only an outer ring of hair. The missionaries have tried to persuade the people to change this habit: but it is the fashion, and that is sufficient answer at Tahiti as well as at Paris. I was much disappointed in the personal appearance of the women; they are far inferior in every respect to the men. The custom of wearing a flower in the back of the head, or through a small hole in each ear, is pretty; the flower is generally either white or scarlet, and like the Camelia Japonica. They wear also a sort of crown of woven cocoa-nut leaves, as a shade to their eyes. The women appear to be in greater want of some becoming costume, even than the men.

Nearly all understand a little English;—that is, they know the names of common things, and by the aid of this,

* The similarity is not closer than between the capital of a Corinthian column and a tuft of acanthus.

together with signs, a lame sort of conversation could be carried on. In returning in the evening to the boat, we stopped to witness a very pretty scene; numbers of children were playing on the beach, and had lighted bonfires, which illuminated the placid sea and surrounding trees. Others, in circles, were singing Tahitian verses. We seated ourselves on the sand, and joined their party. The songs were impromptu, and I believe related to our arrival: one little girl sang a line, which the rest took up in parts, forming a very pretty chorus. The whole scene made us unequivocally aware that we were seated on the shores of an island in the South Sea.

November 17th.—This day is reckoned in the log-book as Tuesday the 17th instead of Monday the 16th, owing to our, so far successful, chase of the sun. Before breakfast the ship was hemmed in by a flotilla of canoes, and when the natives were allowed to come on board, I suppose their numbers could not have been under two hundred. It was the opinion of every one, that it would have been difficult to have picked out an equal number from any other nation, who would have given so little trouble. Every body brought something for sale: shells were the main article of trade. The Tahitians now fully understand the value of money, and prefer it to old clothes or other articles. The various coins, however, of English and Spanish denomination puzzle them, and they never seemed to think the small silver quite secure until changed into dollars. Some of the chiefs have accumulated considerable sums of money. One not long since offered eight hundred dollars (about 160 pounds sterling) for a small vessel; and frequently they purchase whale-boats and horses, at the rate of from fifty to a hundred dollars.

After breakfast I went on shore, and ascended the slope of the nearest part of the mountain, to an elevation between two and three thousand feet. The form of the land is rather singular, and may be understood by explaining its hypothetical origin. I believe the interior mountains once

stood as a smaller island in the sea; and that around their steep flanks, streams of lava and beds of sediment were accumulated under water, in a conical mass. This, after being raised, has been cut by numerous profound ravines, which all diverge from the common centre; the intervening ridges being flat-topped, and belonging to one slope. Having crossed the narrow girt of inhabited and fertile land, I followed the line of one of these ridges; having on each hand, very steep and smooth-sided valleys. The vegetation is singular, consisting almost exclusively of small dwarf ferns, which, higher up, are mingled with coarse grass. The appearance was not very dissimilar from that on some of the Welsh hills; and this being so close above the orchard of tropical plants on the coast, was very surprising. At the highest point which I reached, trees again appeared. Of these three zones of comparative luxuriance, the lower one owes its moisture, and therefore fertility, to its extreme flatness; for being scarcely raised above the level of the sea, the water, which it receives from the higher land, drains away slowly. The upper zone extends into a moister atmosphere; whilst the intermediate part, not being benefited by either of these advantages, is barren. The wood in the upper part was very pretty; tree-ferns having replaced the cocoa-nuts of the coast. It must not, however, be supposed that these woods at all equal the forests of Brazil. In an island, that vast number of productions which characterizes a continent, cannot be expected to occur.

From the point which I attained, there was a good view of the distant island of Eimeo, dependant on the same sovereign with Tahiti. On the lofty and broken pinnacles, white massive clouds were piled up, which formed an island in the blue sky, as Eimeo itself did in the blue ocean. The island, with the exception of one small gateway is completely encircled by a reef. At this distance, a narrow but well-defined line of brilliant white was alone visible, where the waves first encountered the wall of coral. The glassy water of the lagoon was included within this line;

and out of it the mountains rose abruptly. The effect was very pleasing, and might aptly be compared to a framed engraving, where the frame represented the breakers, the marginal paper the lagoon, and the drawing the island itself. When in the evening I descended from the mountain, a man, whom I had pleased with a trifling gift, met me, bringing with him hot roasted bananas, a pine-apple, and cocoa-nuts. After having walked under a burning sun, I do not know any thing more delicious than the milk of a young cocoa-nut. Pine-apples are here so abundant, that the people eat them in the same wasteful manner as we might turnips. They are of an excellent flavour,—perhaps even better than those cultivated in England; and this I believe is the highest compliment which can be paid to a fruit, or indeed to any thing else. Before going on board I went to Mr. Wilson, who interpreted to the Tahitian, who had paid me so adroit an attention, that I wanted him and another man to accompany me on a short excursion into the mountains.

November 18th.—In the morning I came on shore early, bringing with me some provisions in a bag, and two blankets for myself and servant. These were lashed to each end of a pole, and thus carried by my Tahitian companions: from custom these men are able to walk for a whole day, with as much as fifty pounds at each end. I told my guides to provide themselves with food and clothing: but for the latter, they said their skins were sufficient, and for the former, that there was plenty of food in the mountains. The line of march was the valley of Tia-auru, in which the river flows that enters the sea by Point Venus. This is one of the principal streams in the island, and its source lies at the base of the loftiest pinnacles, which attain the elevation of about 7000 feet. The whole island may be considered as one group of mountains, so that the only way to penetrate the interior is to follow up the valleys. Our road, at first, lay through the wood which bordered each side of the river; and the glimpses

of the lofty central peaks, seen as through an avenue, with here and there a waving cocoa-nut tree on one side, were extremely picturesque. The valley soon began to narrow, and the sides to grow lofty and more precipitous. After having walked between three and four hours, we found the width of the ravine scarcely exceeded that of the bed of the stream. On each hand the walls were nearly vertical; yet from the soft nature of the volcanic strata, trees and a rank vegetation sprung from every projecting ledge. These precipices must have been some thousand feet high: and the whole formed a mountain gorge, far more magnificent than any thing which I had ever before beheld. Until the mid-day sun stood vertically over the ravine, the air had felt cool and damp, but now it became very sultry. Shaded by a ledge of rock, beneath a façade of columnar lava, we ate our dinner. My guides had already procured a dish of small fish and fresh-water prawns. They carried with them a small net stretched on a hoop; and where the water was deep and in eddies, they dived, and like otters, by their eyesight followed the fish into holes and corners, and thus secured them.

The Tahitians have the dexterity of amphibious animals in the water. An anecdote mentioned by Ellis shows how much they feel at home in that element. When a horse was landing for Pomarre in 1817, the slings broke, and it fell into the water: immediately the natives jumped overboard, and by their cries and vain efforts at assistance, almost drowned the animal. As soon, however, as it reached the shore, the whole population took to flight, and tried to hide themselves from the man-carrying-pig, as they christened the horse.

A little higher up, the river divided itself into three little streams. The two northern ones were impracticable, owing to a succession of waterfalls, which descended from the jagged summit of the highest mountain; the other to all appearance was equally inaccessible, but we managed to ascend it by a most extraordinary road. The sides of

the valley were here nearly precipitous; but, as frequently happens with stratified rocks, small ledges projected, which were thickly covered by wild bananas, liliaceous plants, and other luxuriant productions of the tropics. The Tahitians, by climbing amongst these ledges, searching for fruit, had discovered a track by which the whole precipice could be scaled. The first ascent from the valley was very dangerous: for it was necessary to pass the face of a naked rock, by the aid of ropes, which we brought with us. How any person discovered that this formidable spot was the only point where the side of the mountain was practicable, I cannot imagine. We then cautiously walked along one of the ledges, till we came to the stream already alluded to. This ledge formed a flat spot, above which a beautiful cascade, of some hundred feet, poured down its waters, and beneath it another high one emptied itself into the main stream. From this cool and shady recess, we made a circuit to avoid the overhanging cascade. As before, we followed little projecting ledges, the apparent danger being partly hidden by the thickness of the vegetation. In passing from one of the ledges to another, there was a vertical wall of rock. One of the Tahitians, a fine active man, placed the trunk of a tree against this, climbed up it, and then by the aid of crevices reached the summit. He fixed the ropes to a projecting point, and lowered them for us, then hauled up a dog which accompanied us, and lastly our luggage. Beneath the ledge on which the dead tree was placed the precipice must have been five or six hundred feet deep; and if the abyss had not been partly concealed by the overhanging ferns and lilies, my head would have turned giddy, and nothing should have induced me to have attempted it. We continued to ascend sometimes along ledges, and sometimes along knife-edged ridges, having on each hand profound ravines. In the Cordillera, I have seen mountains on a far grander scale, but for abruptness, no part of them at all comparable to this. In the evening we reached a flat little spot on the banks of the same stream,

which I have mentioned as descending by a chain of waterfalls. Here we bivouacked for the night. On each side of the ravine there were great beds of the Feyé, or mountain-banana, covered with ripe fruit. Many of these plants were from twenty to twenty-five feet high, and from three to four in circumference. By the aid of strips of bark for twine, the stems of bamboos for rafters, and the large leaf of the banana for a thatch, the Tahitians in a few minutes built an excellent house; and with the withered leaves made a soft bed.

They then proceeded to make a fire, and cook our evening meal. A light was procured by rubbing a blunt-pointed stick in a groove made in another (as if with the intention of deepening it), until by friction the dust became ignited. A peculiarly white and very light wood (the *Hibiscus tiliaceus*) is alone used for this purpose: it is the same which serves for poles to carry any burden, and for the floating outrigger to steady the canoe. The fire was produced in a few seconds: but, to a person who does not understand the art, it requires the greatest exertion; as I found, before at last, to my great pride, I succeeded in igniting the dust. The Gaucho in the Pampas uses a different method: taking an elastic stick about eighteen inches long, he presses one end on his breast, and the other (which is pointed) in a hole in a piece of wood, and then rapidly turns the curved part, like a carpenter's centre-bit. The Tahitians having made a small fire of sticks, placed a score of stones, of about the size of cricket-balls, on the burning wood. In about ten minutes' time the sticks were consumed and the stones hot. They had previously folded up in small parcels of leaves, pieces of beef, fish, ripe and unripe bananas, and the tops of the wild arum. These green parcels were laid in a layer between two layers of the hot stones, and the whole then covered up with earth, so that no smoke or steam could escape. In about a quarter of an hour, the whole was most deliciously cooked. The choice green parcels were now laid on a cloth of banana-

leaves, and with a cocoa-nut shell we drank the cool water of the running stream; and thus we enjoyed our rustic meal.

I could not look on the surrounding plants without admiration. On every side were forests of banana; the fruit of which, though serving for food in various ways, lay in heaps decaying on the ground. In front of us there was an extensive brake of wild sugar-cane; and the stream was shaded by the dark green knotted stem of the Ava,—so famous in former days for its powerful intoxicating effects. I chewed a piece, and found that it had an acrid and unpleasant taste, which would have induced any one at once to have pronounced it poisonous. Thanks be to the missionaries, this plant now thrives only in these deep ravines, innocuous to every one. Close by I saw the wild arum, the roots of which, when well baked, are good to eat, and the young leaves better than spinach. There was the wild yam, and a liliaceous plant called Ti, which grows in abundance, and has a soft brown root, in shape and size like a huge log of wood. This served us for dessert, for it is as sweet as treacle, and with a pleasant taste. There were, moreover, several other wild fruits, and useful vegetables. The little stream, besides its cool water, produced eels and cray-fish. I did indeed admire this scene, when I compared it with an uncultivated one in the temperate zones. I felt the force of the observation, that man, at least savage man, with his reasoning powers only partly developed, is the child of the tropics.

As the evening drew to a close, I strolled beneath the gloomy shade of the bananas up the course of the stream. My walk was soon brought to a close, by coming to a waterfall between two and three hundred feet high; and again above this there was another. I mention all these waterfalls in this one brook, to give a general idea of the inclination of the land. In the little recess where the water fell, it did not appear that a breath of wind had ever entered. The leaves of the banana, damp with spray, possessed an unbroken edge,

instead of being split, as generally is the case, into a thousand shreds. From our position, almost suspended on the mountain-side, there were glimpses into the depths of the neighbouring valleys; and the lofty points of the central mountains, towering up within sixty degrees of the zenith, hid half the evening sky. Thus seated, it was a sublime spectacle to watch the shades of night gradually obscuring the last and highest pinnacles.

Before we laid ourselves down to sleep, the elder Tahitian fell on his knees, and with closed eyes repeated a long prayer in his native tongue. He prayed as a Christian should do, with fitting reverence, and without the fear of ridicule or any ostentation of piety. At our meals neither of the men would taste food, without saying beforehand a short grace. Those travellers, who think that a Tahitian prays only when the eyes of the missionary are fixed on him, should have slept with us that night on the mountain-side. Before morning it rained very heavily; but the good thatch of banana-leaves kept us dry.

November 19th.—At daylight my friends, after their morning prayer, prepared an excellent breakfast in the same manner as in the evening. They themselves certainly partook of it largely; indeed I never saw any men eat nearly so much. I should suppose such capacious stomachs must be the result of a large part of their diet consisting of fruit and vegetables, which contain, in a given bulk, a comparatively small portion of nutriment. Unwittingly, I was the means of my companions breaking (as I afterwards learned) one of their own laws and resolutions. I took with me a flask of spirits, which they could not resolve to refuse; but as often as they drank a little, they put their fingers before their mouths, and uttered the word "Missionary." About two years ago, although the use of the ava was prevented, drunkenness from the introduction of spirits became very prevalent. The missionaries prevailed on a few good men, who saw their country rapidly going to ruin, to join with them in a Temperance Society. From good sense or shame all the chiefs and the

queen were at last persuaded to join it. Immediately a law was passed, that no spirits should be allowed to be introduced into the island, and that he who sold and he who bought the forbidden article, should be punished by a fine. With remarkable justice, a certain period was allowed for stock in hand to be sold, before the law came into effect. But when it did, a general search was made in which even the houses of the missionaries were not exempted, and all the ava (as the natives call all ardent spirits) was poured on the ground. When one reflects on the effect of intemperance on the aborigines of the two Americas, I think it will be acknowledged, that every well-wisher of Tahiti owes no common debt of gratitude to the missionaries. As long as the little island of St. Helena remained under the government of the East India Company, spirits, owing to the great injury they had produced, were not allowed to be imported; but wine was supplied from the Cape of Good Hope. It is rather a striking, and not very gratifying fact, that in the same year that spirits were allowed to be sold on that island, their use was banished from Tahiti by the free will of the people.

After breakfast we proceeded on our journey. As my object was merely to see a little of the interior scenery, we returned by another track, which descended into the main valley lower down. For some distance we wound, by a most intricate path, along the side of the mountain which formed the valley. In the less precipitous parts we passed through extensive groves of the wild banana. The Tahitians, with their naked, tattooed bodies, their heads ornamented with flowers, and seen in the dark shade of the woods, would have formed a fine picture of man, inhabiting some primeval forest. In our descent we followed the line of ridges; these were exceedingly narrow, and for considerable lengths steep as a ladder; but all clothed with vegetation. The extreme care necessary in poising each step rendered the walk fatiguing. I am never weary of expressing my astonishment at these ravines and precipices: the mountains may almost be described, as rent by so many crevices. When

viewing the surrounding country from the knife-edged ridges, the point of support was so small, that the effect was nearly the same, I should think, as from a balloon. In this descent we had occasion to use the ropes only once, at the point where we entered the main valley. We slept under the same ledge of rock, where, the day before, we had dined: the night was fine, but from the depth and narrowness of the gorge, profoundly dark.

Before actually seeing this country, I had difficulty in understanding two facts mentioned by Ellis; namely, that after the murderous battles of former times, the survivors on the conquered side retired into the mountains, where a handful of men could resist a multitude. Certainly half-a-dozen men, at the spot where the Tahitian reared the old tree, could easily have repulsed thousands. Secondly, that after the introduction of Christianity, there were wild men who lived in the mountains, and whose retreats were unknown to the more civilized inhabitants.

November 20th.—In the morning we started early, and reached Matavai at noon. On the road we met a large party of noble athletic men, going for wild bananas. I found that the ship, on account of the difficulty in watering, had moved to the harbour of Papawa, to which place I immediately walked. This is a very pretty spot. The cove is surrounded by reefs, and the water as smooth as that in a lake. The cultivated ground, with all its beautiful productions, and the cottages, comes close down to the water's edge.

From the varying accounts which I had read before reaching these islands, I was very anxious to form, from my own observation, a judgment of their moral state—although such judgment would necessarily be very imperfect. A first impression at all times very much depends on one's previously-acquired ideas. My notions were drawn from Ellis's "Polynesian Researches"—an admirable and most interesting work, but naturally looking at every thing under a favourable point of view; from Beechey's Voyage; and

from that of Kotzebue, which is strongly adverse to the whole missionary system. He who compares these three accounts, will, I think, form a tolerably accurate conception of the present state of Tahiti. One of my impressions, which I took from the two last authorities, was decidedly incorrect; viz., that the Tahitians had become a gloomy race, and lived in fear of the missionaries. Of the latter feeling I saw no trace, unless, indeed, fear and respect be confounded under one name. Instead of discontent being a common feeling, it would be difficult in Europe to pick out of a crowd half so many merry and happy faces. The prohibition of the flute and dancing is inveighed against as wrong and foolish;—the more than presbyterian manner of keeping the sabbath, is looked at in a similar light. On these points I will not pretend to offer any opinion in opposition to men who have resided as many years as I was days on the island.

On the whole it appears to me, that the morality and religion of the inhabitants is highly creditable. There are many who attack, even more acrimoniously than Kotzebue, both the missionaries, their system, and the effects produced by it. Such reasoners never compare the present state with that of the island only twenty years ago; nor even with that of Europe at this day; but they compare it with the high standard of Gospel perfection. They expect the missionaries to effect that, which the Apostles themselves failed to do. In as much as the condition of the people falls short of this high order, blame is attached to the missionary, instead of credit for that which he has effected. They forget, or will not remember, that human sacrifices, and the power of an idolatrous priesthood—a system of profligacy unparalleled in the world, and infanticide a consequence on that system—bloody wars, where the conquerors spared neither women nor children — that all these have been abolished; and that dishonesty, intemperance, and licentiousness have been greatly reduced by the introduction of Christianity. In a voyager to forget these things is base ingratitude; for should he chance to be at the point of shipwreck on some unknown

coast, he will most devoutly pray that the lesson of the missionary may be found to have extended thus far.

In point of morality the virtue of the women, it has been often said, is most open to exception. But before they are blamed too severely, it will be well distinctly to call to mind the scenes described by Captain Cook and Mr. Banks, in which the grandmothers and mothers of the present race played a part. Those who are most severe, should consider how much of the morality of the women in Europe is owing to the system early impressed by mothers on their daughters, and how much in each individual case to the precepts of religion. But it is useless to argue against such reasoners:—I believe that disappointed in not finding the field of licentiousness quite so open as formerly, they will not give credit to a morality which they do not wish to practice, or to a religion which they undervalue, if not despise.

Sunday 22d.—The harbour of Papiete, which may be considered as the capital of the island, is about seven miles distant from Matavai, to which point the Beagle had returned. The queen resides there, and it is the seat of government, and the chief resort of shipping. Captain FitzRoy took a party there to hear divine service, first in the Tahitian language, and afterwards in our own. Mr. Pritchard, the leading missionary in the island, performed the service, which was a most interesting spectacle. The chapel consisted of a large airy framework of wood; and it was filled to excess by tidy, clean people, of all ages and both sexes. I was rather disappointed in the apparent degree of attention; but I believe my expectations were raised too high. At all events the appearance was quite equal to that in a country church in England. The singing of the hymns was decidedly very pleasing; but the language from the pulpit, although fluently delivered, did not sound well. A constant repetition of words, like "*tata ta, mata mai,*" rendered it monotonous. After English service, a party returned on foot to Matavai. It was a pleasant walk, sometimes along the sea-beach and sometimes under the shade of the many beautiful trees.

About two years ago, a small vessel under English colours was plundered by the inhabitants of the Low Islands, which were then under the dominion of the Queen of Tahiti. It was believed that the perpetrators were instigated to this act by some indiscreet laws issued by her majesty. The British government demanded compensation; which was acceded to, and a sum of nearly three thousand dollars was agreed to be paid on the first of last September. The commodore at Lima ordered Captain FitzRoy, to inquire concerning this debt, and to demand satisfaction if it were not paid. Captain FitzRoy accordingly requested an interview with the queen: and a parliament was held to consider the question; at which all the principal chiefs of the island and the queen were assembled. I will not attempt to describe what took place, after the interesting account given by Captain FitzRoy. The money it appeared had not been paid. Perhaps the alleged reasons for the failure were rather equivocating: but otherwise I cannot sufficiently express our general surprise, at the extreme good sense, the reasoning powers, moderation, candour, and prompt resolution, which were displayed on all sides. I believe every one of us left the meeting with a very different opinion of the Tahitians, from that which we entertained when entering. The chiefs and people resolved to subscribe and complete the sum which was wanting: Captain FitzRoy urged that it was hard that their private property should be sacrificed for the crimes of distant islanders. They replied, that they were grateful for his consideration, but that Pomarre was their Queen, and they were determined to help her in this her difficulty. This resolution and its prompt execution (for a book was opened early the next morning), made a perfect conclusion to this very remarkable scene of loyalty and good feeling.

After the main discussion was ended, several of the chiefs took the opportunity of asking Captain FitzRoy many intelligent questions, concerning international customs and laws. These related to the treatment of ships and foreigners. On

some points, as soon as the decision was made, the law was issued verbally on the spot. This Tahitian parliament lasted for several hours; and when it was over Captain FitzRoy invited the queen to pay the Beagle a visit.

November 26th.—In the evening, with a gentle land-breeze, a course was steered for New Zealand, and as the sun set we took a farewell look at the mountains of Tahiti,—the island to which every voyager has offered up his tribute of admiration.

December 19th.—In the evening we saw New Zealand in the distance. We may now consider ourselves as having nearly crossed the Pacific ocean It is necessary to sail over this great sea to understand its immensity. Moving quickly onwards for weeks together we meet with nothing, but the same blue, profoundly deep, ocean. Even within the Archipelagoes, the islands are mere specks, and far distant one from the other. Accustomed to look at maps, drawn on a small scale, where dots, shading, and names are crowded together, we do not judge rightly how infinitely small the proportion of dry land is to the water of this great sea. The meridian of the Antipodes likewise has now been passed; and every league, thanks to our good fortune, which we travel onwards, is one league nearer to England. These Antipodes call to mind old recollections of childish doubt and wonder. Only the other day, I looked forward to this airy barrier, as a definite point in our voyage homewards; but now I find it, and all such resting-places for the imagination, are like shadows which a man moving onwards cannot catch. A gale of wind, which lasted for some days, has lately given us time and inclination to measure the future stages in our long voyage, and to wish most earnestly for its termination.

December 21st.—Early in the morning we entered the Bay of Islands, and being becalmed for some hours near the mouth, we did not reach the anchorage till the middle of the day. The country is hilly, but with a smooth outline; and it is deeply intersected by numerous arms, extending from the bay. The surface appears from a distance, as if clothed

with coarse pasture, but this in truth is nothing but fern. On the more distant hills, as well as in patches in some of the valleys, there is a good deal of wood-land. The general tint of the landscape is not a bright green; and it resembles the country a short distance to the southward of Concepcion in Chile. In several parts of the bay, little villages of square tidy-looking houses were scattered close down to the water's edge. Three whaling ships were lying at anchor; but with the exception of these, and of a few canoes, now and then crossing from one shore to the other, an air of extreme quietness reigned over the whole district. Only a single canoe came alongside. This, and the aspect of the whole scene, afforded a remarkable, and not very pleasing contrast, with our joyful and boisterous welcome at Tahiti.

In the afternoon we went on shore to one of the larger groups of houses, which yet hardly deserves the title of a village. Its name is Pahia: it is the residence of the missionaries; and with the exception of their servants and labourers, there are no native residents. In the vicinity of the Bay of Islands, the number of Englishmen, including their families, amounts to between two and three hundred. All the cottages, many of which are white washed, and look as I have said very neat, are the property of the English. The hovels of the natives are so diminutive and paltry, that they can scarcely be perceived from any distance. At Pahia, it was quite pleasing to behold the English flowers in the platforms before the houses; there were roses of several kinds, honeysuckle, jasmine, stocks, and whole hedges of sweetbriar.

December 22d.—In the morning I went out walking; but I soon found, that the country was very impracticable. All the hills are thickly covered by tall fern, together with a low bush which grows like a cypress; and very little ground has been cleared or cultivated in this neighbourhood. I then tried the sea-beach; but proceeding towards either hand, my walk was soon stopped short, by creeks and deep streams of fresh water. The communication between the inhabitants

of the different parts of the bay, is (as in Chiloe) almost entirely kept up by boats. I was surprised to find that almost every hill, which I ascended, had been at some former time more or less fortified. The summits were cut into steps or successive terraces, and they had been frequently protected by deep trenches. I afterwards observed that the principal hills inland, in like manner showed an artificial outline. These are the Pas, so frequently mentioned by Captain Cook under the name of "hippah"; the difference of sound being owing to the prefixed article.

That the Pas had formerly been used, was evident from the piles of shells, and the pits in which, as I was informed, sweet potatoes were kept as reserved provisions. As there was no water on these hills, the defenders could never have anticipated a long siege, but only a hurried attack for plunder; under which circumstances the successive terraces would have afforded good protection. The general introduction of fire-arms has changed the whole system of warfare; and an exposed situation on the top of a hill would now be worse than useless. The Pas in consequence, is at the present day, always built on a level piece of ground. It consists of a double stockade of thick and tall posts, placed in a zigzag line, so that every part can be flanked. Within the stockade a mound of earth is thrown up, behind which the defenders can rest in safety, or use their fire-arms over it. On the level of the ground, little archways sometimes pass through this breastwork, by which means the defenders can crawl out to the stockade, to reconnoitre their enemies. The Rev. W. Williams, who gave me this account, added, that in one Pas he had noticed spurs or buttresses projecting from the inside of the mound of earth. On asking the chief the use of them, he replied, that if two or three of his men should be shot their neighbours would not see the bodies, and so be discouraged.

These Pases are considered by the New Zealanders as very perfect means of defence: for the attacking force is never so well disciplined as to rush in a body to the stockade, cut

it down, and effect their entry. When a tribe goes to war, the chief cannot order one party to go here, and another there; but every man fights in the manner which best pleases himself; and for individuals to approach a stockade defended by fire-arms, must appear certain death. I should think a more warlike race of inhabitants could not be found in any part of the world, than the New Zealanders. Their conduct on first seeing a ship, as described by Captain Cook, strongly illustrates this: the act of throwing volleys of stones at so great and novel an object, and their defiance, of "Come on shore and we will kill and eat you all," shows uncommon boldness. This warlike spirit is evident in many of their customs, and even in their smallest actions. If a New Zealander is struck, although but in joke, the blow must be returned; and of this I saw an instance with one of our officers.

At the present day, from the progress of civilization, there is much less warfare. When Europeans first traded here, muskets and ammunition far exceeded in value any other article: now they are in little request, and are indeed often offered for sale. Among some of the southern tribes, however, there is still much hostility. I heard a characteristic anecdote of what took place there some time ago. A missionary found a chief and his tribe in preparation for war;—their muskets clean and bright, and their ammunition ready. He reasoned long on the inutility of the war, and the little provocation which had been given for it. The chief was much shaken in his resolution, and seemed in doubt: but at length it occurred to him, that a barrel of his gunpowder was in a bad state, and that it would not keep much longer. This was brought forward as an unanswerable argument for the necessity of immediately declaring war: the idea of allowing so much good gunpowder to spoil was not to be thought of; and this settled the point.

I was told by the missionaries, that in the life of Shongi, the chief who visited England, the love of war was the one and lasting spring of every action. The tribe in which he

was a principal chief, had at one time been much oppressed, by another from the Thames river. A solemn oath was taken by the men, that when their boys should grow up, and they should be powerful enough, they would never forget or forgive these injuries. To fulfil this appears to have been Shongi's chief motive for going to England; and when there it was his sole object. Presents were valued only as they could be converted into arms; of the arts, those alone were interesting, which were concerned with the manufacture of arms. When at Sydney, Shongi, by a strange coincidence, met the hostile chief of the Thames river at the house of Mr. Marsden: their conduct was civil to each other; but Shongi told him, that when again in New Zealand he would never cease to carry war into his country. The challenge was accepted; and Shongi on his return fulfilled the threat to the utmost letter. The tribe on the Thames river was utterly overthrown, and the chief to whom the challenge had been given, was himself killed. Shongi, although harbouring such deep feelings of hatred and revenge, is described as having been a goodnatured person.

In the evening I went with Captain FitzRoy, and Mr. Baker, one of the missionaries, to pay a visit to Kororadika. This is the largest village, and will one day, no doubt increase till it becomes the chief town: besides a considerable native population, there are many English residents. These latter are men of the most worthless character: and among them are many runaway convicts from New South Wales. There are many spirit-shops; and the whole population is addicted to drunkenness and all kinds of vice. As this is the capital, a person would be inclined to form his opinion of the New Zealanders from what he here saw; but in this case his estimate of their character would be too low. This little village is the very stronghold of vice. Although many tribes in other parts have embraced Christianity, here the greater part yet remain in heathenism. In such places the missionaries are held in little esteem: but they complain far more of the conduct of their countrymen, than of that of the natives. It is strange,

but I have heard these worthy men say, that the only protection which they need, and on which they rely, is from the native chiefs against Englishmen.

We wandered about the village, and saw and conversed with many of the people, both men, women, and children. Looking at the New Zealander, one naturally compares him with the Tahitian; both belonging to the same family of mankind. The comparison, however, tells heavily against the New Zealander. He may, perhaps, be superior in energy, but in every other respect, his character is of a much lower order. One glance at their respective expressions, brings conviction to the mind, that one is a savage, the other a civilized man. It would be vain to seek in the whole of New Zealand, a person with the face and mien of the old Tahitian chief, Utamme. No doubt the extraordinary manner in which tattooing is here practised, gives a disagreeable expression to their countenances. The complicated but symmetrical figures covering the whole face, puzzle and mislead an unaccustomed eye: it is moreover probable, that the deep incisions, by destroying the play of the superficial muscles, give an air of rigid inflexibility. But besides this, there is a twinkling in the eye, which cannot indicate any thing but cunning and ferocity. Their figures are tall and bulky; but in elegance are not comparable with those of the working classes in Tahiti.

Both their persons and houses are filthily dirty and offensive: the idea of washing either their bodies or their clothes never seems to enter their heads. I saw a chief, who was wearing a shirt black and matted with filth; and when asked how it came to be so dirty, he replied, with surprise, "Do not you see it is an old one?" Some of the men have shirts; but the common dress is one or two large blankets, generally black with dirt, which are thrown over their shoulders in a very inconvenient and awkward fashion. A few of the principal chiefs have decent suits of English clothes; but these are only worn on great occasions.

Considering the number of foreigners residing in New

Zealand, and the amount of commerce carried on there, the state of government of the country is most remarkable. It is, however, incorrect to use the term government, where absolutely no such thing exists. The land is divided, by well-determined boundaries, between various tribes, independent of each other. The individuals in each tribe consist of freemen, and slaves taken in war; and the land is common to all the free born; that is, each may occupy and till any part that is vacant. In a sale, therefore, of land, every such person must receive part payment. Among the freemen, there will always be some one, who from riches, from talents, or from descent from some noted character, will take the lead; and in this respect he may be considered as the chief. But if the united tribe should be asked, who was their chief, no one would be acknowledged. Without doubt, in many cases, individuals have obtained great influence; but as far as I can understand the system, their power is not legitimate. Even the authority of a master over his slave, or a parent over his child, appears to be regulated by no kind of ordinary custom. Proper laws of course are quite unknown: certain lines of action are generally considered right, and others wrong: if such customs are infringed, the injured person and his tribe, if they have power, seek retribution; if not, they treasure up the recollection of the injury till the day of revenge arrives. If the state in which the Fuegians live should be fixed at zero in the scale of government, I am afraid New Zealand would rank but a few degrees higher; while Tahiti, even when first discovered, would have occupied a respectable position.

December 23d.—At a place called Waimate, about fifteen miles from the Bay of Islands, and midway between the eastern and western coasts, the missionaries have purchased some land for agricultural purposes. I had been introduced to the Rev. W. Williams, who, upon my expressing the wish, invited me to pay him a visit there. Mr. Bushby, the British Resident, offered to take me in his boat by a creek, where I should see a pretty waterfall, and by which means my

walk would be shortened. He likewise procured for me a guide. Upon asking a neighbouring chief to recommend a man, the chief himself offered to go; but his ignorance of the value of money was so complete, that at first he asked how many pounds I would give him; but, afterwards was well contented with two dollars. When I showed the chief a very small bundle, which I wanted carried, it became absolutely necessary to take a slave for that purpose. These feelings of pride are beginning to wear away; but formerly a leading man would sooner have died than undergone the indignity of carrying the smallest burden. My companion was a light active man, dressed in a dirty blanket, and with his face completely tattooed. He had formerly been a great warrior. He appeared to be on very cordial terms with Mr. Bushby; but at various times they had quarrelled violently. Mr. Bushby remarked that a little quiet irony would frequently silence any one of these natives in their most blustering moments. This chief has come and harangued Mr. Bushby in a hectoring manner, saying, "A great chief, a great man, a friend of mine, has come to pay me a visit—you must give him something good to eat, some fine presents, &c." Mr. Bushby has allowed him to finish his discourse, and then has quietly replied by some such answer as, "What else shall your slave do for you?" The man would then instantly, with a very comical expression, cease his braggadocio.

Some time ago, Mr. Bushby suffered a far more serious attack. A chief and a party of men tried to break into his house in the middle of the night, and not finding this so easy, commenced a brisk firing with their muskets. Mr. Bushby was slightly wounded; but the party was at length driven away. Shortly afterwards it was discovered who was the aggressor; and a general meeting of the chiefs was convened to consider the case. It was considered by the New Zealanders as very atrocious, inasmuch as it was a night attack, and that Mrs. Bushby was lying ill in the house: this latter circumstance, much to their honour, being con-

sidered in all cases as a protection. The chiefs agreed to confiscate the land of the aggressor to the King of England. The whole proceeding, however, in thus trying and punishing a chief was entirely without precedent. The aggressor, moreover, lost cast in the estimation of his equals; and this was considered by the British as of more consequence, than the confiscation of his land.

As the boat was shoving off, a second chief stepped into her, who only wanted the amusement of the passage up and down the creek. I never saw a more horrid and ferocious expression, than this man had. It immediately struck me, I had somewhere seen his likeness: it will be found in Retzsch's outlines to Schiller's ballad of Fridolin, where two men are pushing Robert into the burning iron furnace. It is the man who has his arm on Robert's breast. Physiognomy here spoke the truth; this chief had been a notorious murderer, and was to boot an arrant coward. At the point where the boat landed, Mr. Bushby accompanied me a few hundred yards on the road: I could not help admiring the cool impudence of the hoary old villain, whom we left lying in the boat, when he shouted to Mr. Bushby, "Do not you stay long, I shall be tired of waiting here."

We now commenced our walk. The road lay along a well-beaten path, bordered on each side by the tall fern, which covers the whole country. After travelling some miles, we came to a little country village, where a few hovels were collected together, and some patches of ground cultivated for potato crops. The introduction of the potato, has been the most essential benefit to the island; it is now much more used, than any native vegetable. New Zealand is favoured by one great natural advantage; namely, that the inhabitants can never perish from famine. The whole country abounds with fern; and the roots of this plant, if not very palatable, yet contain much nutriment. A native can always subsist on these, and on the shells which are abundant on all parts of the sea-coast. The villages are chiefly conspicuous, by

the platforms which are raised on four posts ten or twelve feet above the ground, and on which the produce of the fields is kept secure from all accidents.

On coming near one of the huts, I was much amused by seeing in due form the ceremony of rubbing, or as it should more properly be called, pressing noses. The women, on our first approach, began uttering something in a most dolorous voice; they then squatted themselves down and held up their faces; my companions standing over them, placed the bridge of their own noses at right angles to theirs, and commenced pressing. This lasted rather longer than a cordial shake of the hand would with us; and as we vary the force of the grasp of the hand in shaking, so do they in pressing. During the process they uttered comfortable little grunts, very much in the same manner as two pigs do, when rubbing against each other. I noticed, that the slave would press noses with any one he met, indifferently either before or after his master the chief. Although among savages the chief has absolute power of life and death over his slave, yet there is an entire absence of ceremony between them. Mr. Burchell has remarked the same thing in Southern Africa with respect to the rude Bachapins. Where civilization has arrived at a certain point, as among the Tahitians, complex formalities are soon instituted between the different grades of society. For instance, in the above island, formerly all were obliged to uncover themselves as low as the waist in presence of the king.

The ceremony of pressing noses having been completed with all present, we seated ourselves in a circle in the front of one of the houses, and rested there half-an-hour. All the native hovels which I have seen, have nearly the same form and dimensions, and all agree in being filthily dirty. They resemble a cow-shed with one end open, but having a partition a little way within, with a square hole in it, which thus cuts off a part, and makes a small gloomy chamber. In this the inhabitants keep all their property, and when the

weather is cold they sleep there. They eat, however, and pass their time in the open part in front.

My guides having finished their pipes, we continued our walk. The path led through the same undulating country, the whole uniformly clothed as before with fern. On our right hand, we had a serpentine river, the banks of which were fringed with trees, and here and there on the hill-sides there were clumps of wood. The whole scene, in spite of its green colour, bore rather a desolate aspect. The sight of so much fern impresses the mind with an idea of sterility. This, however, is not the case; for wherever the fern grows thick and breast-high, the land by tillage becomes productive. Some of the residents, with much probability think that all this extensive open country was originally covered with forests, and that it has been cleared by the aid of fire. It is said that by digging in the barest spots, lumps of the kind of resin which flows from the kauri pine, are frequently found. The natives had an evident motive in thus clearing the country; for in such parts the fern, formerly so staple an article of food, flourishes best. The almost entire absence of associated grasses, which forms so remarkable a feature in the vegetation of this island, may perhaps be accounted for, by the open parts being the work of man, while nature had designed the country for forest land.

The soil is volcanic; in several parts we passed over slaggy and vesicular lavas, and the form of a crater could clearly be distinguished in several of the neighbouring hills. Although the scenery is nowhere beautiful, and only occasionally pretty, I enjoyed my walk. I should have enjoyed it more, if my companion, the chief, had not possessed extraordinary conversational powers. I only knew three words; "good," "bad," and "yes:" and with these I answered all his remarks, without of course having understood one word he said. This, however, was quite sufficient: I was a good listener, an agreeable person, and he never ceased talking to me.

At length we reached Waimate. After having passed over so many miles of an uninhabited useless country, the sudden appearance of an English farm-house, and its well-dressed fields, placed there as if by an enchanter's wand, was exceedingly pleasing. Mr. Williams not being at home, I received in Mr. Davies's house a cordial and pleasant welcome. After drinking tea with his family party, we took a stroll about the farm. At Waimate there are three large houses, where the missionary gentlemen Messrs. Williams, Davies, and Clarke, reside; and near them are the huts of the native labourers. On an adjoining slope fine crops of barley and wheat in full ear were standing; and, in another part, fields of potatoes and clover. But I cannot attempt to describe all I saw; there were large gardens, with every fruit and vegetable which England produces; and many belonging to a warmer clime. I may instance, asparagus, kidney beans, cucumbers, rhubarb, apples, pears, figs, peaches, apricots, grapes, olives, gooseberries, currants, hops, gorze for fences, and English oaks; also many different kinds of flowers. Around the farm-yard there were stables, a thrashing-barn with its winnowing machine, a blacksmith's forge, and on the ground ploughshares and other tools: in the middle was that happy mixture of pigs and poultry, which may be seen so comfortably lying together in every English farm-yard. At the distance of a few hundred yards, where the water of a little rill was dammed up into a pool, a large and substantial water-mill had been erected.

All this is very surprising, when it is considered, that five years ago, nothing but the fern flourished here. Moreover, native workmanship, taught by the missionaries, has effected this change:—the lesson of the missionary is the enchanter's wand. The house has been built, the windows framed, the fields ploughed, and even the trees grafted, by the New Zealander. At the mill, a New Zealander may be seen powdered white with flour, like his brother miller in England. When I looked at this whole scene, I thought it admirable. It was not merely that England was vividly brought before my mind;

yet, as the evening drew to a close, the domestic sounds, the fields of corn, the distant country with its trees now appearing like pasture-land, all might well be mistaken for some part of it. Nor was it the triumphant feeling at seeing what Englishmen could effect, but it was something of far more consequence; the object for which this labour had been bestowed—the moral effect on the aborigines of this fine country.

The missionary system here appears to me different from that of Tahiti; much more attention is there paid to religious instruction, and to the direct improvement of the mind; here, more to the arts of civilization. I do not doubt that in both cases, the same object is kept in view. Judging from the success alone, I should rather lean to the Tahiti side; probably, however, each system is best adapted to the country where it is followed. The mind of a Tahitian is certainly one of a higher order; and on the other hand, the New Zealander, not being able to pluck from the tree that shades his house the bread-fruit and banana, would naturally turn his attention with more readiness to the arts. When comparing the state of New Zealand with that of Tahiti, it should always be remembered, that from the respective forms of government of the two countries, the missionaries here have had to labour at a task, many times more difficult. The reviewer of Mr. Earle's travels in the Quarterly Journal, by pointing out a more advantageous line of conduct for the missionaries, evidently considers that too much attention has been paid to religious instruction, in proportion to other subjects. This opinion being so very different from the one at which I arrived, any third person hearing the two sides, would probably conclude, that the missionaries had been the best judges, and had chosen the right path.

Several young men were employed about the farm, who had been brought up by the missionaries; having been redeemed by them from slavery. They were dressed in a shirt, jacket and trousers, and had a respectable appearance. Judging from one trifling anecdote, I should think they must be

honest. When walking in the fields, a young labourer came up to Mr. Davies, and gave him a knife and gimlet, saying he had found them on the road, and did not know to whom they belonged! These young men and boys appeared very merry and good-humoured. In the evening I saw a party of them at cricket: when I thought of the austerity of which the missionaries have been accused, I was amused by observing one of their own sons taking an active part in the game. A more decided and pleasing change was manifested in the young women, who acted as servants within the houses. Their clean, tidy, and healthy appearance, like that of dairy-maids in England, formed a wonderful contrast with the women of the filthy hovels in Kororadika. The wives of the missionaries tried to persuade them not to be tattooed; but a famous operator having arrived from the south, they said, "We really must just have a few lines on our lips; else when we grow old our lips will shrivel, and we shall be so very ugly." Tattooing is not nearly so much practised as formerly; but as it is a badge of distinction between the chief and the slave, it will not probably very soon be disused. So soon does any train of ideas become habitual, that the missionaries told me, that even in their eyes, a plain face looked mean, and not like that of a New Zealand gentleman.

Late in the evening I went to Mr. Williams's house, where I passed the night. I found there a very large party of children, collected together for Christmas-day, and all sitting round a table at tea. I never saw a nicer or more merry group: and to think, that this was in the centre of the land of cannibalism, murder, and all atrocious crimes! The cordiality and happiness so plainly pictured in the faces of the little circle, appeared equally felt by the older persons of the mission.

December 24th.—In the morning, prayers were read in the native tongue to the whole family. After breakfast, I rambled about the gardens and farm. This was a market-day, when the natives of the surrounding hamlets bring

their potatoes, Indian corn, or pigs, to exchange for blankets, tobacco, and sometimes, through the persuasions of the missionaries, for soap. Mr. Davies's eldest son, who manages a farm of his own, is the man of business in the market. The children of the missionaries, who came while young to the island, understand the language better than their parents, and can get any thing more readily done by the natives.

A little before noon, Messrs. Williams and Davies walked with me to part of a neighbouring forest, to show me the famous Kauri pines. I measured one of these noble trees, in a part which was not enlarged near the roots, and found it to be thirty-one feet in circumference. There was another close by, which I did not see, thirty-three; and I heard of one, no less than forty feet. The trunks are also very remarkable from their smoothness, cylindrical figure, absence of branches, and having very nearly the same girth through a length from sixty to even ninety feet. The crown of this tree, where it is irregularly branched, is small, and out of proportion to the trunk; and the foliage is likewise diminutive as compared with the branches. The forest in this part was almost composed of the Kauri; and the largest, from the parallelism of their sides, stood up like gigantic columns of wood. The timber of this tree is the most valuable product of the island: moreover, a quantity of resin oozes from the bark, which is collected and sold at a penny a pound to the Americans, but its use is kept secret.

On the outskirts of the wood, I saw the New Zealand flax growing in the swamps: this is the second most valuable export. This plant somewhat resembles (but not botanically) the common iris; the under surface of the leaf is lined by a layer of strong silky fibres; and the upper consists of green vegetable matter, which is scraped off with a broken shell, and the hemp remains in the hand of the workwoman. In the forest, besides the kauri, there are some other fine timber trees. I saw numbers of beautiful tree-ferns, and was told of palms. Some of the New Zealand forests must

be impenetrable to an extraordinary degree. Mr. Matthews gave me an account of one, which, although only thirty-four miles wide, and separating two inhabited districts, like the central forest of Chiloe, had never been passed until lately. He and another missionary, each with a party of about fifty men, undertook to open a road: but it cost them more than a fortnight's labour! In the woods I saw very few birds. With regard to animals, it is a most remarkable fact, that so large an island, extending over more than 700 miles in latitude, and in many parts ninety broad, with varied stations, a fine climate, and land of all heights, from 14,000 feet downwards, with the exception of a small rat, should not possess one indigenous animal. It is moreover said, that the introduction of the common Norway kind, has annihilated from the northern extremity of the island, the New Zealand species, in the short space of two years. In many places I noticed several sorts of weeds, which, like the rats, I was forced to own as countrymen. A leek, however, which has overrun whole districts, and will be very troublesome, was imported lately by the favour of a French vessel. The common dock is widely disseminated, and will, I am afraid, for ever remain a proof of the rascality of an Englishman, who sold the seeds for those of the tobacco-plant.

On returning from our pleasant walk to the houses, I dined with Mr. Williams; and then, a horse being lent me, I returned to the Bay of Islands. I took leave of the missionaries, with thankfulness for their kind welcome, and with feelings of high respect for their gentleman-like, useful, and upright characters. I think it would be difficult to find a body of men better adapted for the high office which they fulfil.

Christmas-day.—In a few more days, the fourth year of our absence from England will be completed. Our first Christmas-day was spent at Plymouth; the second at St. Martin's Cove, near Cape Horn; the third at Port Desire, in Patagonia; the fourth at anchor in a harbour in the

Peninsula of Tres Montes; this fifth here; and the next, I trust in providence, will be in England. We attended divine service in the chapel of Pahia; part of the service was read in English, and part in the New Zealand language.

As far as I was able to understand, the greater number of people in this northern part of the island profess Christianity. It is curious, that the religion even of those who do not profess it, has been modified and is now partly Christian, partly heathen. Moreover, so excellent is the Christian faith, that the outward conduct even of the unbelievers is said to have been decidedly improved by the spread of its doctrines. It is beyond doubt, however, that much immorality still exists; — that there are many who would not hesitate to kill a slave for a trifling offence; and that polygamy is still common, — indeed, I believe, general.

We did not hear of any recent act of cannibalism; but Mr. Stokes found burnt human bones, strewed round an old fireplace, on a small island near the anchorage: these remains of some quiet banquet might, indeed, have been lying there for several years. Notwithstanding the above facts, it is probable that the moral state of the people will rapidly improve. Mr. Bushby mentioned one pleasing anecdote as a proof of the sincerity of some, at least, of those who profess Christianity. One of his young men left him, who had been accustomed to read prayers to the rest of the servants. Some weeks afterwards, happening to pass late in the evening by an outhouse, he saw and heard one of his men reading the bible with difficulty, by the light of the fire, to the others. After this, the party knelt and prayed: in their prayers they mentioned Mr. Bushby and his family, and the missionaries, each separately in his respective district.

December 26th.—Mr. Bushby offered to take Mr. Sulivan and myself in his boat, some miles up the river to Cawa-Cawa; and proposed afterwards to walk on to the village of Waiomio, where there are some curious rocks. Following one of the arms of the bay, we enjoyed a pleasant row,

and passed through pretty scenery, until we came to a village, beyond which the boat could not proceed. From this place a chief and a party of men volunteered to walk with us to Waiomio, a distance of four miles. The chief was at this time rather notorious, from having lately hung one of his wives and a slave, for adultery. When one of the missionaries remonstrated with him, he seemed surprised, and said he thought he was exactly following the English method. Old Shongi, who happened to be in England during the Queen's trial, expressed great disapprobation at the whole proceeding: he said he had five wives, and he would rather cut off all their heads, than be so much troubled about one. Leaving this village, we crossed over to another, seated on a hill-side at a little distance. The daughter of a chief, who was still a heathen, had died here five days before. The hovel in which she had expired had been burnt to the ground: her body being enclosed between two small canoes was placed upright on the ground, and protected by an enclosure bearing wooden images of their gods, and the whole was painted bright red, so as to be conspicuous from afar. Her gown was fastened to the coffin, and her hair being cut off was cast at its foot. The relatives of the family had torn the flesh of their arms, bodies, and faces, so that they were covered with clotted blood; and the old women looked most filthy, disgusting objects. On the following day some of the officers visited this place, and found the women still howling and cutting themselves.

We continued our walk, and soon reached Waiomio. Here there are some singular masses of limestone, resembling ruined castles. These rocks have long served for burial-places, and in consequence are held sacred. One of the young men cried out, "Let us all be brave," and ran on ahead; but when within a hundred yards, the whole party thought better of it, and stopped short. With perfect indifference, however, they allowed us to examine the whole place. At this village we rested some hours, during which

time there was a long discussion with Mr. Bushby, concerning the right of sale of certain lands. One old man, who appeared a perfect genealogist, illustrated the successive possessors by bits of stick driven into the ground. Before leaving the houses, a little basketful of roasted sweet-potatoes was given to each of our party; and we all, according to the custom, carried them away to eat on the road. I noticed that among the women employed in cooking, there was a man-slave: it must be an humiliating thing for a man in this warlike country to be employed in doing that which is considered as the lowest woman's work. Slaves are not allowed to go to war; but this perhaps can hardly be considered as a hardship. I heard of one poor wretch who, during hostilities, ran away to the opposite party; being met by two men, he was immediately seized; but they not agreeing to whom he should belong, each stood over him with a stone hatchet, and seemed determined that the other at least should not take him away alive. The poor man, almost dead with fright, was only saved by the address of a chief's wife. We afterwards enjoyed a pleasant walk back to the boat, but did not reach the ship till late in the evening.

December 30th.—In the afternoon we stood out of the Bay of Islands on our course to Sydney. I believe we were all glad to leave New Zealand. It is not a pleasant place. Amongst the natives there is absent that charming simplicity which is found at Tahiti; and the greater part of the English are the very refuse of society. Neither is the country itself attractive. I look back but to one bright spot, and that is Waimate, with its Christian inhabitants.

CHAPTER XXI.

Sydney—Prosperity—Excursion to Bathurst—Aspect of woods—Party of Natives—Gradual extinction of aborigines — Blue Mountains—Weatherboard—View of a grand gulf-like valley—Sheep farm—Lion-ant—Bathurst, general civility of lower orders—State of society—Van Diemen's Land — Hobart Town—Aborigines all banished—Mount Wellington—King George's Sound—Cheerless aspect of country—Bald Head, calcareous casts like branches of trees—Party of natives—Leave Australia.

AUSTRALIA.

January 12th, 1836 —Early in the morning, a light air carried us towards the entrance of Port Jackson. Instead of beholding a verdant country scattered over with fine houses: a straight line of yellowish cliff brought to our minds the coast of Patagonia. A solitary lighthouse, built of white stone, alone told us we were near a great and populous city. Having entered the harbour, it appeared fine and spacious; but the level country, showing on the cliff-formed shores bare and horizontal strata of sandstone, was covered by woods of thin scrubby trees, that bespoke useless sterility. Proceeding further inland, the country improved; beautiful villas and nice cottages were here and there scattered along the beach. In the distance stone houses, two and three stories high, and windmills, standing on the edge of a bank, pointed out to us the neighbourhood of the capital of Australia.

At last we anchored within Sydney Cove. We found the little basin occupied by many large ships, and surrounded by warehouses. In the evening I walked through the town, and returned full of admiration at the whole scene. It is a most magnificent testimony to the power of the British nation. Here, in a less promising country, scores of years have effected many times more, than the same number of centuries have done in South America. My first feeling

was to congratulate myself that I was born an Englishman. Upon seeing more of the town afterwards, perhaps my admiration fell a little; but yet it is a fine town; the streets are regular, broad, clean, and kept in excellent order; the houses are of a good size, and the shops well furnished. It may be faithfully compared to the large suburbs, which stretch out from London and a few other great towns in England: but not even near London or Birmingham is there an appearance of such rapid growth. The number of large houses just finished and others building was truly surprising; nevertheless, every one complained of the high rents and difficulty in procuring a house. In the streets, gigs, phaetons, and carriages with livery servants, were driving about; and of the latter, many were extremely well equipped. Coming from South America, where in the towns every man of property is known, no one thing surprised me more than not being able to ascertain readily to whom this or that carriage belonged.

Many of the older residents say, that formerly they knew every face in the colony, but now that in a morning's ride it is a chance if they know one. Sydney has a population of twenty-three thousand, and is rapidly increasing: it must contain much wealth. It appears that a man of business can hardly fail to make a large fortune. I saw on all sides fine houses,—one built from the profits of steam-vessels,—another from building, and so on. An auctioneer, who was a convict, it is said, intends to return home, and will take with him 100,000 pounds. Another has an income so large that scarcely any body ventures to guess at it—the least sum assigned being fifteen thousand a year. But the two crowning facts are,—first, that the public revenue has increased 60,000*l.* during this last year; and secondly, that less than an acre of land within the town of Sydney sold for 8000*l.* sterling.

I hired a man and two horses to take me to Bathurst; a village about one hundred and twenty miles in the interior, and the centre of a great pastoral district. By this means I hoped to get a general idea of the appearance of the

country. On the morning of the 16th (January) I set out on my excursion. The first stage took us to Paramatta, a small country-town, the second to Sydney in importance. The roads were excellent, and made upon the MacAdam principle: whinstone having been brought for the purpose from the distance of several miles. The road appeared much frequented by all sorts of carriages; and I met two stage-coaches. In all these respects there was a close resemblance to England; perhaps the number of alehouses was here in excess. The iron gangs, or parties of convicts, who have here committed some trifling offence, appeared the least like England; they were working in chains, under the charge of sentries with loaded arms. The power, which the government possesses, by means of forced labour, of at once opening good roads throughout the country, has been, I believe, one main cause of the early prosperity of this colony.

I slept at night at a very comfortable inn at Emu ferry, thirty-five miles from Sydney, and near the ascent of the Blue Mountains. This line of road is the most frequented, and has been longest inhabited of any in the colony. The whole land is enclosed with high railings, for the farmers have not succeeded in rearing hedges. There are many substantial houses and good cottages scattered about; but although considerable pieces of land are under cultivation, the greater part yet remains as when first discovered. Making allowances for the cleared parts, the country here resembled all that I saw during the ten succeeding days.

The extreme uniformity of the vegetation is the most remarkable feature in the landscape of the greater part of New South Wales. Every where we have an open woodland; the ground being partially covered with a very thin pasture. The trees nearly all belong to one family; and mostly have the surface of their leaves placed in a vertical, instead of as in Europe, a nearly horizontal position: the foliage is scanty, and of a peculiar, pale green tint, without any gloss. Hence the woods appear light and shadowless: this,

although a loss of comfort to the traveller under the scorching rays of summer, is of importance to the farmer, as it allows grass to grow where it otherwise could not. The leaves are not shed periodically: this character appears common to the entire southern hemisphere, namely, South America, Australia, and the Cape of Good Hope. The inhabitants of this hemisphere and of the intertropical regions, thus lose perhaps one of the most glorious, though to our eyes common, spectacles in the world,—the first bursting into full foliage of the leafless tree. They may, however, say that we pay dearly for our spectacle, by having the land covered with mere naked skeletons for so many months. This is too true; but our senses thus acquire a keen relish for the exquisite green of the spring, which the eyes of those living within the tropics, sated during the long year with the gorgeous productions of those glowing climates, can never experience. The greater number of the trees, with the exception of some of the blue gums, do not attain a large size; but they grow tall and tolerably straight, and stand well apart. The bark of some falls annually, or hangs dead in long shreds, which swing about with the wind; and hence the woods appear desolate and untidy. Nowhere is there an appearance of verdure, but rather that of arid sterility. I cannot imagine a more complete contrast in every respect than between the forests of Valdivia, or Chiloe, and the woods of Australia.

Although this colony flourishes so remarkably, the appearance of infertility is to a certain degree real. The soil without doubt is good, but there is so great a deficiency both of rain and running water, that it cannot produce much. The agricultural crops, and often those in gardens, are estimated to fail once in three years; and this has even happened on successive years. Hence the colony cannot supply itself with the bread and vegetables, which its inhabitants consume. It is essentially pastoral, and chiefly so for sheep, and not the larger quadrupeds. The alluvial land near Emu ferry was some of the best cultivated which I saw; and certainly the scenery on the banks of the

Nepean, bounded to the west by the Blue Mountains, was pleasing even to the eye of a person thinking of England.

At sunset, a party of a score of the black aborigines passed by, each carrying, in their accustomed manner, a bundle of spears and other weapons. By giving a leading young man a shilling, they were easily detained, and threw their spears for my amusement. They were all partly clothed, and several could speak a little English; their countenances were goodhumoured and pleasant; and they appeared far from being such utterly degraded beings as they are usually represented. In their own arts they are admirable: a cap being fixed at thirty yards distance, they transfixed it with a spear, delivered by the throwing stick, with the rapidity of an arrow from the bow of a practised archer. In tracking animals or men they show most wonderful sagacity; and I heard of several of their remarks which manifested considerable acuteness. They will not, however, cultivate the ground, or build houses and remain stationary, or even take the trouble of tending a flock of sheep when given to them. On the whole they appear to me to stand some few degrees higher in the scale of civilization than the Fuegians.

It is very curious thus to see in the midst of a civilized people, a set of harmless savages wandering about without knowing where they shall sleep at night, and gaining their livelihood by hunting in the woods. As the white man has travelled onwards, he has spread over the country belonging to several tribes. These, although thus enclosed by one common people, keep up their ancient distinctions, and sometimes go to war with each other. In an engagement which took place lately, the two parties most singularly chose the centre of the village of Bathurst, for the field of battle. This was of service to the defeated side, for the runaway warriors took refuge in the barracks.

The number of aborigines is rapidly decreasing. In my whole ride, with the exception of some boys brought up in the houses, I saw only one other party; these were rather

more numerous than the first, and not so well clothed. This decrease, no doubt, must be partly owing to the introduction of spirits, to European diseases (even the milder ones of which, as the measles,* prove very destructive), and to the gradual extinction of the wild animals. It is said that numbers of their children invariably perish in very early infancy from the effects of their wandering life. As the difficulty of procuring food increases, so must their wandering habits; and hence the population, without any apparent deaths from famine, is repressed in a manner extremely sudden compared to what happens in civilized countries, where the father may add to his labour, without destroying his offspring.

Besides these several evident causes of destruction, there appears to be some more mysterious agency generally at work. Wherever the European has trod, death seems to pursue the aboriginal. We may look to the wide extent of the Americas, Polynesia, the Cape of Good Hope, and Australia, and we shall find the same result. Nor is it the white man alone, that thus acts the destroyer; the Polynesian of Malay extraction has in parts of the East Indian archipelago, thus driven before him the dark-coloured native. The varieties of man seem to act on each other; in the same way as different species of animals—the stronger always extirpating the weaker. It was melancholy at New Zealand to hear the fine energetic natives saying, they knew the land was doomed to pass from their children. Every one has heard of the inexplicable reduction of the population in the beautiful and healthy island of Tahiti since the date of Captain Cook's voyages: although in that case we might have expected it would have been otherwise; for infanticide, which formerly

* It is remarkable how the same disease is modified in different climates. At the little island of St. Helena, the introduction of scarlet fever is dreaded as a plague. In some countries, foreigners and natives are as differently affected by certain contagious disorders, as if they had been different animals; of which fact some instances have occurred in Chile; and, according to Humboldt, in Mexico. (Polit. Essay on Kingdom of New Spain, vol. iv.)

prevailed to so extraordinary a degree, has ceased, and the murderous wars have become less frequent.

The Rev. J. Williams, in his interesting work,* says, that the first intercourse between natives and Europeans, "is invariably attended with the introduction of fever, dysentery, or some other disease, which carries off numbers of the people." Again he affirms, "It is certainly a fact, which cannot be controverted, that most of the diseases which have raged in the islands during my residence there, have been introduced by ships;† and what renders this fact remarkable is, that there might be no appearance of disease among the crew of the ship, which conveyed this destructive importation." This statement is not quite so extraordinary as it at first appears; for several cases are on record of the most malignant fevers having broken out, although the parties themselves, who were the cause, were not affected. In the early part of the reign of George III., a prisoner who had been confined in a dungeon, was taken in a coach with four constables before a magistrate; and, although the man himself was not ill, the four constables died from a short putrid fever; but the contagion extended to no others.

* Narrative of Missionary Enterprise, p. 282.

† Captain Beechey (chap. iv., vol. i.) states that the inhabitants of Pitcairn Island, are firmly convinced that after the arrival of every ship they suffer cutaneous and other disorders. Captain Beechey attributes this to the change of diet during the time of the visit. Dr. Macculloch (Western Isles, vol. ii., p. 32) says, "It is asserted, that on the arrival of a stranger (at St. Kilda) all the inhabitants, in the common phraseology, catch a cold." Dr. Macculloch considers the whole case, although often previously affirmed, as ludicrous. He adds, however, that "the question was put by us to the inhabitants who unanimously agreed in the story." In Vancouver's Voyage, there is a somewhat similar statement with respect to Otaheite: nor are these (as I believe) the only instances. Humboldt (Polit. Essay on King. of New Spain, vol. iv.) says, that the great epidemics at Panama and Callao are "marked" by the arrival of ships from Chile, because the people from that temperate region, first experience the fatal effects of the torrid zones. I may add, that I have heard it stated in Shropshire, that sheep, which have been imported from vessels, although themselves in a healthy condition, if placed in the same fold with others, frequently produce sickness in the flock.

From these facts it would almost appear as if, the effluvium of one set of men shut up for some time together, was poisonous when inhaled by others (and perhaps more so, if the men be of different races). Mysterious as this circumstance appears to be, it is not more surprising than that the body of one's fellow-creature, directly after death, and before putrefaction has commenced, should often be of so deleterious a quality, that the mere puncture from an instrument used in its dissection should prove fatal.

January 17th.—Early in the morning we passed the Nepean in a ferry-boat. The river, although at this spot both broad and deep, had a very small body of running water. Having crossed a low piece of land on the opposite side, we reached the slope of the Blue Mountains. The ascent is not steep, the road having been cut with much care on the side of a sandstone cliff. At no great elevation an almost level plain extends, which, rising imperceptibly to the westward, at last attains a height of more than three thousand feet. From so grand a title as Blue Mountains, and from their absolute altitude, I expected to have seen a bold chain of mountains crossing the country; but instead of this, a sloping plain presents merely an inconsiderable front to the low land of the coast. From this first slope, the view of the extensive woodland to the eastward, was striking, and the surrounding trees grew bold and lofty. But when once on the sandstone platform, the scenery becomes exceedingly monotonous; each side of the road is bordered by scrubby trees of the never-failing Eucalyptus family; and with the exception of two or three small inns, there are no houses, or cultivated land: the road, moreover, is solitary; the most frequent object being a bullock-waggon, piled up with bales of wool.

In the middle of the day we baited our horses at a little inn, called the Weatherboard. The country here is elevated 2800 feet above the sea. About a mile and a half from this place, there is a view exceedingly well worth visiting. By following down a little valley and its tiny rill of water, an

immense gulf is unexpectedly seen through the trees which border the pathway, at the depth of perhaps 1500 feet. Walking on a few yards one stands on the brink of a vast precipice, and below is the grand bay or gulf (for I know not what other name to give it), thickly covered with forest. The point of view is situated as if at the head of a bay, the line of cliff diverging on each side, and showing headland behind headland, as on a bold sea-coast. These cliffs are composed of horizontal strata of whitish sandstone; and so absolutely vertical are they, that in many places, a person standing on the edge, and throwing down a stone, can see it strike the trees in the abyss below. So unbroken is the line, that it is said, in order to reach the foot of the waterfall, formed by this little stream, it is necessary to go a distance of sixteen miles round. About five miles distant in front, another line of cliff extends, which thus appears completely to encircle the valley; and hence the name of bay is justified, as applied to this grand amphitheatrical depression. If we imagine a winding harbour, with its deep water surrounded by bold cliff-like shores, laid dry, and a forest sprung up on its sandy bottom, we should then have the appearance and structure here exhibited. This kind of view was to me quite novel, and extremely magnificent.

In the evening, we reached the Blackheath. The sandstone plateau has here attained the elevation of 3400 feet; and is covered, as before, with the same kind of scrubby wood. From the road there were occasional glimpses into a profound valley, of the same character as the one described; but from the steepness and depth of its sides, the bottom was scarcely ever to be seen. The Blackheath is a very comfortable inn, kept by an old soldier; and it reminded me of the small inns in North Wales. I was surprised to find that here, at the distance of more than seventy miles from Sydney, fifteen beds could be made up for travellers.

January 18th.—Very early in the morning, I walked about three miles to see Govett's Leap: a view of a similar but even perhaps more stupendous character than that near

the Weatherboard. So early in the day the gulf was filled with a thin blue haze, which, although destroying the general effect, added to the apparent depth at which the forest was stretched below the country on which we were standing. Soon after leaving the Blackheath, we descended from the sandstone platform by the pass of Mount Victoria. To effect this pass, an enormous quantity of stone has been cut through; the design, and its manner of execution, would have been worthy of any line of road in England,—even that of Holyhead. We now entered upon a country less elevated by nearly a thousand feet, and consisting of granite. With the change of rock, the vegetation improved; the trees were both finer, and stood further apart; and the pasture between them was a little greener, and more plentiful.

At Hassan's Walls, I left the high road, and made a short detour to a farm called Walerawang; to the superintendent of which, I had a letter of introduction from the owner in Sydney. Mr. Browne had the kindness to ask me to stay the ensuing day, which I had much pleasure in doing. This place offers an example of one of the large farming, or rather sheep-grazing, establishments of the colony. Cattle and horses are, however, in this case, rather more numerous than usual, owing to some of the valleys being swampy, and producing a coarser pasture. The sheep were 15,000 in number, of which the greater part were feeding under the care of different shepherds, on unoccupied ground, at the distance of more than a hundred miles, and beyond the limits of the colony. Mr. Browne had just finished, this day, the last of the shearing of seven thousand sheep; the rest being sheared in another place. I believe the profit of the average produce of wool from 15,000 sheep, would be more than 5000*l.* sterling. Two or three flat pieces of ground near the house were cleared and cultivated with corn, which the harvest men were now reaping: but no more wheat is sown than sufficient for the annual support of the labourers employed on the establishment. The usual number of assigned convict servants here is about

forty, but at the present time there were rather more. Although the farm was well stocked with every requisite, there was an apparent absence of comfort; and not even a single woman resided here. The sunset of a fine day will generally cast an air of happy contentment on any scene; but here, at this retired farm-house, the brightest tints on the surrounding woods could not make me forget that forty hardened, profligate men, were ceasing from their daily labours, like the slaves from Africa, yet without their just claim for compassion.

Early on the next morning, Mr. Archer, the joint superintendent, had the kindness to take me out Kangaroo-hunting. We continued riding the greater part of the day, but had very bad sport, not seeing a kangaroo, or even a wild dog. The greyhounds pursued a kangaroo rat into a hollow tree, out of which we dragged it: it is an animal as big as a rabbit, but with the figure of a kangaroo. A few years since, this country abounded with wild animals; but now the emu is banished to a long distance, and the kangaroo is become scarce; to both, the English greyhound is utterly destructive. It may be long before these animals are altogether exterminated, but their doom is fixed. The natives are always anxious to borrow the dogs from the farm-houses: the use of them, the offal when an animal is killed, and milk from the cows, are the peace-offerings of the settlers, who push further and further towards the interior. The thoughtless aboriginal, blinded by these trifling advantages, is delighted at the approach of the white man, who seems predestined to inherit the country of his children.

Although having bad sport, we enjoyed a pleasant ride. The woodland is generally so open that a person on horseback can gallop through it. It is traversed by a few flat-bottomed valleys, which are green and free from trees: in such spots the scenery was like that of a park, and pretty. In the whole country I scarcely saw a place without the marks of fire; whether these had been more or less recent—whether the stumps were more or less black, was the greatest change which varied the uniformity, so wearisome to the

traveller's eye. In these woods there are not many birds; I saw, however, some large flocks of the white cockatoo feeding in a corn-field, and a few most beautiful parrots; crows like our jackdaws were not uncommon, and another bird something like the magpie. The English have not been very particular in giving names to the productions of Australia; trees of one genus (Casuarina) are called oaks for no one reason that I can discover, without it is that there is no one point of resemblance. Some quadrupeds are called tigers and hyenas, simply because they are carnivorous, and so on in many other cases.

In the dusk of the evening I took a stroll along a chain of ponds, which in this dry country represented the course of a river, and had the good fortune to see several of the famous Platypus, or *Ornithorhyncus paradoxus*. They were diving and playing about the surface of the water, but showed so little of their bodies that they might easily have been mistaken for water-rats. Mr. Browne shot one: certainly it is a most extraordinary animal; the stuffed specimens do not at all give a good idea of the recent appearance of its head and beak; the latter becoming hard and contracted.

A little time before this I had been lying on a sunny bank, and was reflecting on the strange character of the animals of this country as compared with the rest of the world. An unbeliever in every thing beyond his own reason might exclaim, "Two distinct Creators must have been at work; their object, however, has been the same, and certainly the end in each case is complete." While thus thinking, I observed the hollow conical pitfall of the lion-ant: first a fly fell down the treacherous slope and immediately disappeared; then came a large but unwary ant; its struggles to escape being very violent, those curious little jets of sand, described by Kirby* as being flirted by the insects tail, were promptly directed against the expected

* Kirby's Entomology, vol. i., p. 425. The Australian pitfall is only about half the size of the one made by the European species.

victim. But the ant enjoyed a better fate than the fly, and escaped the fatal jaws which lay concealed at the base of the conical hollow. There can be no doubt but that this predacious larva belongs to the same genus with the European kind, though to a different species. Now what would the sceptic say to this? Would any two workmen ever have hit upon so beautiful, so simple, and yet so artificial a contrivance? It cannot be thought so: one Hand has surely worked throughout the universe.

January 20th.—A long day's ride to Bathurst. Before joining the high road we followed a mere path through the forest; and the country, with the exception of a few squatters' huts, was very solitary. A "squatter" is a freed, or "ticket of leave" man, who builds a hut with bark on unoccupied ground, buys or steals a few animals, sells spirits without a licence, receives stolen goods,—and so at last becomes rich and turns farmer: he is the horror of all his honest neighbours. A "crawler" is an assigned convict, who runs away, and lives how he can, by labour and petty theft. The "bush ranger" is an open villain, who subsists by highway robbery and plunder: generally he is desperate, and will sooner be killed than taken alive. In the country it is necessary to understand these three names, for they are in common use.

This day we experienced the sirocco-like wind of Australia, which comes from the parched deserts of the interior. Clouds of dust were travelling in every direction; and the wind felt like that which has passed over a fire. I afterwards heard that the thermometer out of doors stood at 119°, and in a room in a closed house at 96°. In the afternoon we came in view of the downs of Bathurst. These undulating, but nearly level plains are very remarkable in this country, from being absolutely destitute of a single tree. They support only a very thin brown pasture. We rode some miles across this kind of country, and then reached the township of Bathurst, which is seated in the middle of what may be called either a very broad valley or narrow plain.

Bathurst has a singular and not very inviting appearance. Groups of small houses and a few large ones are scattered rather thickly over two or three miles of a bare country, which is divided into numerous fields by lines of rails. A good many gentlemen live in the neighbourhood, and some possess very comfortable houses. A hideous little red brick church stands by itself on a hill; and barracks and government buildings occupy the centre of the township. I was told not to form too bad an opinion of the country by judging from that on the road-side, nor too good a one from Bathurst; in this latter respect I did not feel myself in the least danger of being prejudiced. It must be confessed that the season had been one of great drought, and that the country did not wear a favourable aspect; although I understand it was incomparably worse two or three months before. The secret of the rapidly growing prosperity of Bathurst is, that the brown pasture which appears to the stranger's eye so wretched is excellent for sheep-grazing.

The town stands on the banks of the Macquarie: this is one of the rivers whose waters flow into the vast and scarcely known interior. The line of watershed, which divides the inland streams from those of the coast, has an elevation of about 3000 feet (Bathurst is 2200), and runs in a north and south direction at the distance of about eighty or a hundred miles from the sea-side. The Macquarie figures in the map as a respectable river, and is the largest of those that drain this part of the inland slope; yet to my surprise I found it a mere chain of ponds, separated from each other by spaces almost dry. Generally a small stream is running, and sometimes there are high and impetuous floods. Scanty as the supply of the water is throughout this district, it becomes still scantier further inland.

January 22d.—I commenced my return, and followed a new road, called Lockyer's Line, in which the country is rather more hilly and picturesque. This was a long day's ride; and the house where I wished to sleep was some way off the road, and not easily found. I met on this, and in-

deed on all other occasions, a very general and ready civility among the lower orders; which, when one considers what they are, and what they have been, would scarcely have been expected. The farm where I passed the night was owned by two young men who had only lately come out, and were beginning a settler's life. The total want of almost every comfort was not very attractive; but future and certain prosperity was before their eyes, and that not far distant.

The next day we passed through large tracts of country in flames, volumes of smoke sweeping across the road. Before noon we joined our former track, and ascended Mount Victoria. I slept at the Weatherboard, and before dark took another walk to the amphitheatre. On the road to Sydney I spent a very pleasant evening with Captain King at Dunheved: and thus ended my little excursion in the colony of New South Wales.

Before arriving here the three things which interested me most were,—the state of society amongst the higher classes, the condition of the convicts, and the degree of attraction sufficient to induce persons to emigrate. Of course, after so very short a visit one's opinion is worth scarcely any thing; but it is as difficult not to form some opinion, as it is to form a correct judgment. On the whole, from what I heard, more than from what I saw, I was disappointed in the state of society. The whole community is rancorously divided into parties on almost every subject. Among those, who from their station in life ought to be the best, many live in such open profligacy, that respectable people cannot associate with them. There is much jealousy between the children of the rich emancipist and the free settlers; the former being pleased to consider honest men as interlopers. The whole population, poor and rich, are bent on acquiring wealth; amongst the higher orders wool and sheep-grazing form the constant subject of conversation. The very low ebb of literature is strongly marked by the emptiness of the booksellers' shops; for they are inferior even to those in the smaller country-towns of England.

There are many serious drawbacks to the comforts of families; the chief of which, perhaps, is being surrounded by convict servants. How thoroughly odious to every feeling to be waited on by a man, who the day before, perhaps, was flogged, from your representation, for some trifling misdemeanor. The female servants are of course much worse; hence children learn the vilest expressions, and it is fortunate if not equally vile ideas.

On the other hand, the capital of a person without any trouble on his part, produces him treble interest to what it will in England; and with care he is sure to grow rich. The luxuries of life are in abundance and very little dearer, and most articles of food cheaper, than in England. The climate is splendid and quite healthy; but to my mind its charms are lost by the uninviting aspect of the country. Settlers possess a great advantage in finding their sons of service, when very young. At the age of from sixteen to twenty they frequently take charge of distant farming stations; this, however, must happen at the expense of their boys associating entirely with convict servants. I am not aware that the tone of society has assumed any peculiar character; but with such habits, and without intellectual pursuits, it can hardly fail to deteriorate. My opinion is such, that nothing but rather severe necessity should compel me to emigrate.

The rapid prosperity and future prospects of this colony are to me, not understanding these subjects, very puzzling. The two main exports are wool and whale-oil; and to both of these productions there is a limit. The country is totally unfit for canals; therefore there is a line not very distant, beyond which the land carriage of wool will not repay the expense of shearing and tending sheep. Pasture every where is so thin, that settlers have already pushed far into the interior: moreover the country further inland becomes extremely poor. I have before said that agriculture can never succeed on a very extended scale; therefore so far as I can see, Australia must ultimately depend upon being the centre of commerce for the southern hemisphere, and perhaps on

her future manufactories. Possessing coal, she always has the moving power at hand. From the habitable country extending along the coast, and from her English extraction she is sure to be a maritime nation. I formerly imagined that Australia would rise to be as grand and powerful a country as North America; but now it appears to me such future grandeur is rather problematical.

With respect to the state of the convicts, I had still fewer opportunities of judging than on other points. The first question is, whether their condition is at all one of punishment: no one will maintain that it is a very severe one. This, however, I suppose is of little consequence as long as it continues to be an object of dread to criminals at home. The corporeal wants of the convicts are tolerably well supplied; their prospect of future liberty and comfort is not distant, and after good conduct certain. A "ticket of leave," which, as long as a man keeps clear of suspicion as well as of crime, makes him free within a certain district, is given upon good conduct after years proportional to the length of the sentence. For life, eight years is the time of probation; for seven years, four, &c. Yet with all this, and overlooking the previous imprisonment and wretched passage out, I believe the years of assignment are passed away with discontent and unhappiness. As an intelligent man remarked to me, the convicts know no pleasure beyond sensuality, and in this they are not gratified. The enormous bribe which government possesses in offering free pardons, together with the deep horror of the secluded penal settlements, destroys confidence between the convicts, and so prevents crime. As to a sense of shame, such a feeling does not appear to be known, and of this I witnessed some very singular proofs. Though it is a curious fact, I was universally told, that the character of the convict population is one of arrant cowardice: not unfrequently some become desperate and quite indifferent of life, yet a plan requiring cool or continued courage is seldom put into execution. The worst feature in the whole case is, that although there

exists what may be called a legal reform, and comparatively little which the law can touch is committed, yet that any moral reform should take place appears to be quite out of the question. I was assured by well-informed people, that a man who should try to improve, could not while living with other assigned servants:—his life would be one of intolerable misery and persecution. Nor must the contamination of the convict ships and prisons both here and in England be forgotten. On the whole, as a place of punishment the object is scarcely gained; as a real system of reform it has failed, as perhaps would every other plan: but as a means of making men outwardly honest,—of converting vagabonds most useless in one hemisphere into active citizens of another, and thus giving birth to a new and splendid country—a grand centre of civilization—it has succeeded to a degree perhaps unparalleled in history.

VAN DIEMEN'S LAND.

January 30th.—The Beagle sailed for Hobart Town in Van Diemen's Land. On the 5th of February, after a six days' passage, of which the first part was fine, and the latter very cold and squally, we entered the mouth of Storm Bay: the weather justified this awful name. The bay should rather be called an estuary, for it receives at its head the waters of the Derwent. Near the mouth there are some extensive basaltic platforms; but higher up, the land becomes mountainous and is covered by a light wood. The lower parts of the hills which skirt the bay are cleared; and the bright yellow fields of corn, and dark green ones of potatoes appeared very luxuriant. Late in the evening we anchored in the snug cove, on the shores of which stands the capital of Tasmania, as Van Diemen's Land is now called. The first aspect of the place was very inferior to that of Sydney; the latter might be called a city, this only a town.

In the morning I walked on shore. The streets are fine

and broad; but the houses rather scattered: the shops appeared good. The town stands at the base of Mount Wellington, a mountain, 3100 feet high, but of very little picturesque beauty: from this source, however, it receives a good supply of water. Round the cove there are some fine warehouses, and on one side a small fort. Coming from the Spanish settlements, where such magnificent care has generally been paid to the fortifications, the means of defence in these colonies appeared very contemptible. Comparing the town to Sydney, I was chiefly struck with the comparative fewness of the large houses, either built or building. This circumstance must indicate that fewer people are gaining large fortunes. The growth, however, of small houses has been most abundant; and the vast number of little red brick dwellings, scattered on the hill behind the town, sadly destroys its picturesque appearance. Hobart Town, from the census of this year, contained 13,826 inhabitants, and the whole of Tasmania 36,505.

All the aborigines have been removed to an island in Bass's Straits, so that Van Diemen's Land enjoys the great advantage of being free from a native population. This most cruel step seems to have been quite unavoidable, as the only means of stopping a fearful succession of robberies, burnings, and murders, committed by the blacks; but which sooner or later must have ended in their utter destruction. I fear there is no doubt that this train of evil and its consequences, originated in the infamous conduct of some of our countrymen. Thirty years is a short period, in which to have banished the last aboriginal from his native island,—and that island nearly as large as Ireland. I do not know a more striking instance of the comparative rate of increase of a civilized over a savage people.

The correspondence to show the necessity of this step, which took place between the government at home and that of Van Diemen's Land, is very interesting: it is published in an appendix to Bischoff's History of Van Diemen's Land. Although numbers of natives were shot and taken prisoners in the skirmishing which was going on at intervals

for several years; nothing seems fully to have impressed them with the idea of our overwhelming power, until the whole island, in 1830, was put under martial law, and by proclamation the whole population desired to assist in one great attempt to secure the entire race. The plan adopted was nearly similar to that of the great hunting-matches in India: a line reaching across the island was formed, with the intention of driving the natives into a *cul-de-sac* on Tasman's peninsula. The attempt failed; the natives, having tied up their dogs, stole during one night through the lines. This is far from surprising, when their practised senses, and accustomed manner of crawling after wild animals is considered. I have been assured that they can conceal themselves on almost bare ground, in a manner which until witnessed is scarcely credible. The country is every where scattered over with blackened stumps, and the dusky natives are easily mistaken for these objects. I have heard of a trial between a party of Englishmen and a native who stood in full view on the side of a bare hill. If the Englishmen closed their eyes for scarcely more than a second, he would squat down, and then they were never able to distinguish the man from the surrounding stumps. But to return to the hunting-match; the natives understanding this kind of warfare, were terribly alarmed, for they at once perceived the power and numbers of the whites. Shortly afterwards a party of thirteen belonging to two tribes came in; and, conscious of their unprotected condition, delivered themselves up in despair. Subsequently by the intrepid exertions of Mr. Robinson, an active and benevolent man, who fearlessly visited by himself the most hostile of the natives, the whole were induced to act in a similar manner. They were then removed to Gun Carriage Island, where food and clothes were provided them. I fear from what I heard at Hobart Town, that they are very far from being contented: some even think the race will soon become extinct.

The Beagle staid here ten days, and in this time I made several pleasant little excursions, chiefly with the object of

examining the geological structure of the immediate neighbourhood. The main points of interest consist, first in the presence of certain basaltic rocks which evidently have flowed as lava; secondly, in some great unstratified masses of greenstone; thirdly, in proofs of an exceedingly small rise of the land; fourthly, in some ancient fossiliferous strata, probably of the age of the Silurian system of Europe; and lastly, in a a solitary and superficial patch of yellowish limestone or travertin, which contains numerous impressions of leaves of trees and plants, not now existing. It is not improbable that this one small quarry, includes the only remaining record of the vegetation of Van Diemen's Land during one former epoch.

Mr. Frankland, the surveyor-general, was kind enough to give me much interesting information, and to take me several pleasant rides. The climate here is damper than in New South Wales, and hence the land is more fertile. Agriculture flourishes here: the cultivated fields looked well, and the gardens abounded with thriving vegetables and fruit-trees. Some of the farm-houses, situated in retired spots, had a very tempting appearance. The general aspect of the vegetation is similar to that of Australia: perhaps it is a little more green and cheerful; and the pasture between the trees rather more abundant. One day I took a long walk on the side of the bay opposite to the town: I crossed in a steam-boat, two of which are constantly plying backwards and forwards. The machinery of one of these vessels was entirely manufactured in this colony, which, from its very foundation then numbered only three-and-thirty years! If I was obliged to emigrate, I think I would choose this place in preference to Sydney: the climate and aspect of the country alone would almost determine me. Moreover, I suspect society is here on a pleasanter footing; certainly it is free from the contamination of rich convicts, and the dissensions consequent on the existence of two classes of wealthy residents. The colony appeared extremely well governed; the streets at night being kept even more orderly than those of an English town.

On another day I ascended Mount Wellington; I took

with me a guide, for I failed in a first attempt, from the thickness of the wood. My guide, however, was a stupid fellow, and conducted us to the southern and damp side of the mountain, where the vegetation was very luxuriant, and the labour of the ascent, from the number of rotten trunks, almost as great as on a mountain in Tierra del Fuego or in Chiloe. It cost us five and a half hours of hard climbing before we reached the summit. In many parts the gum-trees grew to a great size, and the whole composed a noble forest. In some of the dampest ravines, tree-ferns flourished in an extraordinary manner; I saw one which must have been, at least, twenty feet high to the base of the fronds, and was in girth exactly six feet. The foliage of these trees, forming so many most elegant parasols, created a gloomy shade, like that of the first hour of night. The summit of the mountain is broad and flat, and is composed of huge angular masses of naked greenstone. Its elevation is 3100 feet above the level of the sea. The day was splendidly clear, and we enjoyed a most extensive view; to the northward the country appeared a mass of wooded mountains, of about the same elevation and tame outline with the one on which we were standing: to the south, the outline of the broken land and water, forming many intricate bays, was mapped with clearness before us. After staying some hours on the summit, we found a better way to descend, but did not reach the Beagle till eight o'clock, after a severe day's work.

February 17th.—The Beagle sailed from Tasmania, and, on the 6th of the ensuing month, reached King George's Sound, situated near the S.W. corner of Australia. We staid there eight days; and I do not remember, since leaving England, having passed a more dull, uninteresting time. The country, viewed from an eminence, appears a woody plain, with here and there rounded and partly bare hills of granite protruding. One day I went out with a party, in hopes of seeing a kangaroo hunt, and walked over a good many miles of country. Every where we found the soil sandy, and very poor; it either supported a coarse vegetation of thin,

low brushwood and wiry grass, or a forest of stunted trees. The scenery resembled the elevated sandstone platform of the Blue Mountains; the Casuarina (a tree somewhat resembling a Scotch fir) is, however, here in greater number, as the Eucalyptus is in rather less. In the open parts there were many grass-trees;—a plant which, in appearance, has some affinity with the palm; but, instead of being surmounted by a crown of noble fronds, it can boast merely of a tuft of coarse grass. The general bright green colour of the brushwood and other plants, viewed from a distance, seemed to bespeak fertility. A single walk, however, will quite dispel such an illusion; and he who thinks with me, will never wish to walk again in so uninviting a country.

One day I accompanied Captain FitzRoy to Bald Head; the place mentioned by so many navigators, where some imagined they saw coral, and others petrified trees, standing in the position in which they grew. According to our view, the rock was formed by the wind heaping up calcareous sand, during which process, branches and roots of trees, and land-shells were enclosed; the mass being afterward consolidated by the percolation of rain-water. When the wood had decayed, lime was washed into the cylindrical cavities, and became hard, sometimes even like that in a stalactite. The weather is now wearing away the softer rock, and in consequence the casts of roots and branches project above the surface: their resemblance to the stumps of a dead shrubbery was so exact, that, before touching them, we were sometimes at a loss to know which were composed of wood, and which of calcareous matter.

A large tribe of natives, called the White Cockatoo men, happened to pay the town a visit while we were there. These men, as well as those of the tribe belonging to King George's Sound, being tempted by the offer of some tubs of rice and sugar, were persuaded to hold a "corrobery," or great dancing-party. As soon as it grew dark, small fires were lighted, and the men commenced their toilet, which consisted in painting themselves white in spots and lines. As soon as all was ready, large fires were kept blazing,

round which the women and children were collected as spectators; the Cockatoo and King George's men formed two distinct parties, and danced generally in answer to each other. The dancing consisted in the whole set running either sideways or in Indian file, into an open space, and stamping the ground with great force as they marched together. Their heavy footsteps were accompanied by a kind of grunt, and, by beating their clubs and weapons, and various other gesticulations, such as extending their arms, and wriggling their bodies. It was a most rude, barbarous scene, and, to our ideas, without any sort of meaning; but we observed that the women and children watched the whole proceeding with the greatest pleasure. Perhaps these dances originally represented some scenes, such as wars and victories; there was one called the Emu dance, in which each man extended his arm in a bent manner, so as to imitate the neck of that bird. In another dance, one man took off the movements of a kangaroo grazing in the woods, whilst a second crawled up, and pretended to spear him. When both tribes mingled in the dance, the ground trembled with the heaviness of their steps, and the air resounded with their wild cries. Every one appeared in high spirits, and the group of nearly naked figures, viewed by the light of the blazing fires, all moving in hideous harmony, formed a perfect representation of a festival amongst the lowest barbarians. In Tierra del Fuego, we have beheld many curious scenes in savage life, but never, I think, one where the natives were in such high spirits, and so perfectly at their ease. After the dancing was over, the whole party formed a great circle on the ground, and the boiled rice and sugar was distributed, to the delight of all.

After several tedious delays from clouded weather, on the 14th of March, we gladly stood out of King George's Sound on our course to Keeling Island. Farewell, Australia! you are a rising infant and doubtless some day will reign a great princess in the south: but you are too great and ambitious for affection, yet not great enough for respect. I leave your shores without sorrow or regret.

CHAPTER XXII.

Keeling Island—Singular appearance—Scanty Flora—Transport of seeds—Birds and insects—Ebbing and flowing springs—Coral formations resisting power of ocean—Fields of dead coral—Stones transported by roots of trees—Great crab—Stinging corals—Structure of lagoon islands—Encircling and Barrier reefs—General proofs of subsidence in the Pacific—Theory of lagoon islands caused by subsidence of the land—Pacific and Indian oceans divided into alternate areas of elevation and subsidence—Points of eruption lie within the areas of elevation.

CORAL FORMATIONS.

April 1st.—We arrived in view of the Keeling or Cocos Islands, situated in the Indian ocean, and about six hundred miles distant from the coast of Sumatra. This is one of the lagoon islands of coral formation, similar to those we passed in the Dangerous Archipelago. An excellent idea of the general appearance of these extraordinary rings of land, which rise out of the depths of the ocean, may be obtained from the characteristic sketch of Whitsunday Island, in Beechey's Voyage.

When the ship was in the channel at the entrance, Mr. Liesk, an English resident, came off in his boat. The history of the inhabitants of this place, in as few words as possible, is as follows. About nine years ago, a Mr. Hare, a very worthless character, brought from the East Indian archipelago a number of Malay slaves, which now, including children, amount to more than a hundred. Shortly afterwards, Captain Ross, who had before visited these islands in his merchant-ship, arrived from England, bringing with him his family and goods for settlement. Along with him came Mr. Liesk, who had been a mate in his vessel. The Malay slaves soon ran away from the island on which Mr. Hare was settled, and joined Captain Ross's party. Mr. Hare upon this was ultimately obliged to leave these islands.

The Malays are now nominally in a state of freedom, and certainly are so, as far as regards their personal treatment; but in most other points they are considered as slaves. From the discontented state of the people, the repeated removals, and, perhaps, also from a little mismanagement, things are not very prosperous. The island has no quadruped, excepting the pig, and no vegetable in any quantity excepting the cocoa-nut. On the latter the whole prosperity of the place depends. The only exports are oil from the nut, and the cocoa-nut* itself. On it the pigs, which are loaded with fat, almost entirely subsist, as likewise do the poultry and ducks. Even a huge land-crab is furnished by nature with a curious instinct and form of legs to open and feed on this same fruit.

The annular reef of this lagoon island is surmounted in the greater part of its length by linear islets. On the northern or leeward side there is an opening, through which vessels reach the anchorage. On entering, the scene was very curious and rather pretty; its beauty, however, being solely dependant on the brilliancy of the surrounding colours. The shallow, clear, and still water of the lagoon, resting in its greater part on white sand, is, when illuminated by a vertical sun, of a most vivid green. This brilliant expanse, several miles in width, is on all sides divided, either from the dark heaving water of the ocean by a line of snow-white breakers, or from the blue vault of heaven by the strips of land, crowned at an equal height by the tops of the cocoa-nut trees. As a white cloud here and there affords a pleasing contrast with the azure sky, so in the lagoon, dark bands of living coral appear through the emerald green water.

The next morning after anchoring, I went on shore on Direction Island. The strip of dry land is only a few hundred yards wide; on the lagoon side we have a white calcareous beach, the radiation from which in such a climate is

* The nuts are carried to Singapore and to Mauritius; the white part being grated into a pulp, is used in making curries, and is said greatly to improve that dish.

very oppressive; and on the outer coast, a solid broad flat of coral rock, which serves to break the violence of the open sea. Excepting near the lagoon where there is some sand, the land is entirely composed of rounded fragments of coral. In such a loose, dry, stony soil, the climate of the intertropical regions alone could produce a vigorous vegetation. On some of the smaller islets, nothing could be more elegant, than the manner in which the young and full-grown cocoa-nut trees, without destroying each other's symmetry, were mingled into one wood. A beach of glittering white sand formed a border to these fairy spots.

I will now give a sketch of the natural history of these islands, which, from its very paucity, possesses a peculiar interest. The cocoa-nut tree, at the first glance, seems to compose the whole wood; there are, however, five or six other kinds. One of these grows to a very large size, but, from the extreme softness of its wood, is useless; another sort affords excellent timber for ship-building. Besides the trees, the number of plants is exceedingly limited, and consists of insignificant weeds. In my collection, which includes, I believe, nearly the perfect Flora, there are twenty species, without reckoning a moss, lichen, and fungus. To this number two trees must be added; one of which was not in flower, and the other I only heard of. The latter is a solitary tree of its kind in the whole group, and grows near the beach, where, without doubt, the one seed was thrown up by the waves. I do not include in the above list, the sugar-cane, banana, some other vegetables, fruit-trees, and imported grasses. As these islands consist entirely of coral, and at one time probably existed as a mere water-washed reef, all the productions now living here, must have been transported by the waves of the sea. In accordance to this, the Flora has quite the character of a refuge for the destitute: Professor Henslow informs me, that of the twenty species, nineteen belong to different genera, and these again to no less than sixteen orders!

In Holman's* Travels, an account is given on the authority of Mr. A. S. Keating, who resided twelve months on these islands, of the various seeds, and other bodies, which have been known to have been washed on shore. "Seeds and plants from Sumatra and Java have been driven up by the surf on the windward side of the islands. Among them have been found the Kimiri, native of Sumatra and the peninsula of Malacca; the cocoa-nut of Balci, known by its shape and size; the Dadass, which is planted by the Malays with the pepper-vine, the latter intwining round its trunk, and supporting itself by the prickles on its stem; the soap-tree; the castor-oil plant; trunks of the sago palm; and various kinds of seeds unknown to the Malays who settled on the islands. These are all supposed to have been driven on shore by the N.W. monsoon to the coast of New Holland, and thence to these islands by the S.E. trade-wind. Large masses of Java teak, and yellow wood, have also been found, besides immense trees, of red and white cedar, and the blue gum-wood of New Holland, in a perfectly sound condition. All the hardy seeds, such as creepers, retain their germinating power, but the softer kinds, among which is the mangostin, are destroyed in the passage. Fishing-canoes, apparently from Java, have at times been washed on shore." It is interesting thus to discover how numerous the seeds are, which, coming from several countries, are drifted over the wide ocean. Professor Henslow tells me, he believes that nearly all the plants which I brought from this island, are common littoral species in the East Indian archipelago. From the direction, however, of the winds and currents, it seems scarcely possible that they can have come here in a direct line. If, as suggested with much probability by Mr. Keating, they have first been carried towards the coast of New Holland, and thence drifted back again, together with the productions of

* Holman's Travels, vol. iv., p. 378.

that country, the seeds, before germinating, must have travelled between 1800 and 2400 miles.

Chamisso,* when describing the Radack Archipelago, situated in the central part of the Western Pacific, states that, "The sea brings to these islands the seeds and fruits of many trees, most of which have yet not grown here. The greater part of these seeds appear to have not yet lost the capability of growing." It is also said that trunks of northern firs are washed on shore, which must have been floated from an immense distance. These facts are highly interesting. It cannot be doubted, if there were land-birds to pick up the seeds when first cast on shore, and a soil more adapted for their growth than the loose blocks of coral, that such islands, although so isolated, would soon possess a more abundant Flora.

The list of land-animals is even poorer than that of plants. Some of the islets are inhabited by rats; and their origin is known to be due to a ship from the Mauritius, which was wrecked here. These rats have rather a different appearance from the English kind; they are smaller and much more brightly coloured. There are no true land-birds; for a snipe and a rail (*Rallus phillippensis*), though living entirely among the dry herbage, belong to the order of Waders. Birds of this order are said to occur on several of the low islands in the Pacific. At Ascension a rail (*Porphyrio?*) was shot near the summit of the mountain; and it was evidently a solitary straggler. From these circumstances, I believe, the waders are the first colonists of any island, after the innumerable web-footed species. I may add, that whenever I have noticed birds, which were not pelagic, very far out at sea, they always belonged to this order; and hence they would naturally become the earliest colonist of any distant point.

Of reptiles, I saw only one small lizard. Of insects, I took pains to collect every kind. Exclusive of spiders, which

* Kotzebue's First Voyage, vol. iii., p. 155.

were numerous, there were thirteen species.* Of these, one only was a beetle. A small species of ant, swarmed by thousands under the loose dry blocks of coral, and was the only true insect which was abundant. Although the productions of the land are thus scanty; if we look to the waters of the surrounding sea, the number of organic beings is indeed infinite.

Chamisso† has described the natural history of Romanzoff, a lagoon island in the Radack Archipelago. The number and kind of productions there is very nearly the same with those here. One small lizard was seen: wading birds (Numenius and Scolopax) were numerous, and very tame. Of plants, he states there were nineteen species (including one fern); and some of them are the same species with those I collected here, although on an island situated in a different ocean.

These strips of land are raised only to that height, to which the surf can throw fragments, and the wind heap up sand. Their protection is due to the outward and lateral increase of the reef, which thus breaks the sea. The aspect and constitution of these islets at once call up the idea, that the land and the ocean are here struggling for mastery: although terra-firma has obtained a footing, the denizens of the other element think their claim at least equal. In every part one meets hermit-crabs of more than one species,‡ carrying on their backs the houses they have stolen from the neighbouring beach. Overhead, the trees are occupied by numbers of gannets, frigate-birds, and terns.

* The thirteen species belong to the following orders. *Coleoptera*, a species of minute Elater; *Orthoptera*, a Gryllus and Blatta; *Hemiptera*, one; *Homoptera*, two; *Neuroptera*, a Chrysopa; *Hymenoptera*, two ants; *Lepidoptera Nocturna*, a Diopæa, and a Pterophorus (?). *Diptera*, two.

† Kotzebue's First Voyage, vol. iii., p. 222.

‡ The large claws or pincers of some of these crabs, are most beautifully adapted, when drawn back, to form an operculum to the shell, which is nearly as perfect as the proper one that belonged to the original molluscous animal. I was assured, and as far as my observation went it was confirmed, that there are certain kinds of these hermits, which always use certain kinds only of old shells.

From the many nests and smell of the atmosphere, this might be called a sea-rookery. The gannets, sitting on their rude nests, look at an intruder with a stupid, yet angry air. The noddies, as their name expresses, are silly little creatures. But there is one charming bird; it is a small and snow-white tern, which smoothly hovers at the distance of an arm's length from your head; its large black eye scanning with quiet curiosity your expression. Little imagination is required to fancy, that so light and delicate a body must be tenanted by some wandering fairy spirit.

Sunday, April 3d.—After service I accompanied Captain FitzRoy to the settlement, situated at the distance of some miles, on a point thickly scattered over with tall cocoa-nut trees. Captain Ross and Mr. Liesk live in a large barn-like house open at both ends, and lined with mats made of woven bark. The houses of the Malays are arranged along the shore of the lagoon. The whole place had rather a desolate aspect, because there were no gardens to show the signs of care and cultivation. The natives belong to different islands in the East Indian Archipelago, but all speak the same language: we saw inhabitants of Borneo, Celebes, Java, and Sumatra. In the colour of their skin they resemble the Tahitians, nor do they widely differ from them in form of features. Some of the women, however, showed a good deal of the Chinese character. I liked both their general expression and the sound of their voices. They appeared poor, and their houses were destitute of furniture; but it was evident, from the plumpness of the little children, that cocoa-nuts and turtle afford no bad sustenance.

On this island the wells are situated from which ships obtain water. At first sight it appears not a little remarkable that the fresh water should regularly ebb and flow with the usual tide.* We must believe that the compressed sand

* These ebbing and flowing wells are common in parts of the West Indies. The simple fact, that in low islands of small extent, and composed of porous materials, the rain-water can have no tendency to sink lower than the level of the surrounding sea, and must therefore accumulate

or porous coral rock acts like a sponge; and that the rain water which falls on the ground being specifically lighter than the salt merely floats on its surface, and is subject to the same movements. There can be no actual attraction between salt and fresh water, and the spongy texture must tend to prevent all admixture from slight disturbances. On the other hand, where the foundation consists only of loose fragments, upon a well being dug, salt or brackish water enters; of which fact we saw an instance on this same island.

After dinner we stayed to see a half superstitious scene acted by the Malay women. They dress a large wooden spoon in garments, carry it to the grave of a dead man, and then at the full of the moon they pretend it becomes inspired, and will dance and jump about. After the proper preparations, the spoon held by two women became convulsed, and danced in good time to the song of the surrounding children and women. It was a most foolish spectacle, but Mr. Liesk maintained that many of the Malays believed in its spiritual movement. The dance did not commence till the moon had risen, and it was well worth remaining to behold her bright globe so quietly shining through the long arms of the cocoa-nuts, as they waved in the evening breeze. These scenes of the tropics are in themselves so delicious, that they almost equal those dearer ones to which we are bound by each best feeling of the mind.

The next day I employed myself in examining the very interesting yet simple structure and origin of these islands. The water being unusually smooth I waded in as far as the living mounds of coral, on which the swell of the open sea breaks. In some of the gullies and hollows there were beautiful green and other coloured fishes, and the forms and tints of many of the zoophytes were admirable. It is excusable to grow enthusiastic over the infinite numbers of organic beings with which the sea of the tropics, so prodigal

near the surface, having been overlooked; it has been supposed that sand possesses the power of filtering the salt which is dissolved in the sea-water.

of life, teems; yet I must confess I think those naturalists who have described in well-known words the submarine grottoes decked with a thousand beauties, have indulged in rather exuberant language.

April 6th.—I accompanied Captain FitzRoy to an island at the head of the lagoon: the channel was exceedingly intricate, winding through fields of delicately branched corals. We saw several turtle, and two boats were then employed in catching them. The method is rather curious: the water is so clear and shallow, that although at first a turtle quickly dives out of sight, yet in a canoe, or boat under sail, the pursuers after no very long chase come up to it. A man standing ready in the bows, at this moment dashes through the water upon the turtle's back; then clinging with both hands by the shell of its neck, he is carried away till the animal becomes exhausted and is secured. It was quite an interesting chase to see the two boats thus doubling about, and the men dashing into the water trying to seize their prey.

When we arrived at the head of the lagoon, we crossed the narrow islet and found a great surf breaking on the windward coast. I can hardly explain the cause, but there is to my mind a considerable degree of grandeur in the view of the outer shores of these lagoon islands. There is a simplicity in the barrier-like beach, the margin of green bushes and tall cocoa-nuts, the solid flat of coral rock, strewed here and there with great fragments, and the line of furious breakers, all rounding away towards either hand. The ocean throwing its waters over the broad reef appears an invincible, all-powerful enemy, yet we see it resisted and even conquered by means which at first seem most weak and inefficient.

It is not that the ocean spares the rock of coral; the great fragments scattered over the reef, and accumulated on the beach, whence the tall cocoa-nut springs, plainly bespeak the unrelenting power of its waves. Nor are there any periods of repose granted. The long swell, caused by the gentle but steady action of the trade-wind always blowing in

one direction over a wide area, causes breakers, which even exceed in violence those of our temperate regions, and which never cease to rage. It is impossible to behold these waves without feeling a conviction that an island, though built of the hardest rock, let it be porphyry, granite, or quartz, would ultimately yield and be demolished by such irresistible forces. Yet these low, insignificant coral islets stand and are victorious: for here another power, as antagonist to the former, takes part in the contest. The organic forces separate the atoms of carbonate of lime one by one from the foaming breakers, and unite them into a symmetrical structure. Let the hurricane tear up its thousand huge fragments; yet what will this tell against the accumulated labour of myriads of architects at work night and day, month after month. Thus do we see the soft and gelatinous body of a polypus, through the agency of the vital laws, conquering the great mechanical power of the waves of an ocean, which neither the art of man, nor the inanimate works of nature could successfully resist.

We did not return on board till late in the evening, as we staid some time in the lagoon collecting specimens of the giant Chama, and looking at the coral fields. Near the head of the lagoon I was much surprised to find a wide area, considerably more than a mile square, covered with a forest of branching coral, which though standing upright was all dead and rotten. At first I was quite at a loss to understand the cause; afterwards it occurred to me that it was owing to the following rather curious combination of circumstances. It should, however, first be stated, that corals are never able to survive even a short exposure in the air to the sun's rays, so that their upward limit of growth is determined by that of lowest water at spring tides. It appears from some old charts, that the long island to windward was formerly separated by wide channels into several islets; this fact is likewise indicated by the less age of the trees in certain portions. Under this former condition of the reef, a strong breeze, by throwing more water over the barrier, would tend to raise

the level of the lagoon. Now it acts in a directly contrary manner; for the water, not only is not increased by currents from the outside, but is blown outwards by the force of the wind. Hence, it is observed, that the tides near the head of the lagoon do not rise so high during strong breezes as on ordinary occasions. This difference of level, although no doubt very small, has I believe caused the death of those coral groves, which under the former condition of things had attained the utmost possible limit of upward growth.

A few miles north of Keeling there is another small lagoon island, the centre of which is nearly filled up. Captain Ross found in the conglomerate of the outer coast a well rounded fragment of greenstone, rather larger than a man's head; he and the men with him were so much surprised at this, that they brought it away and preserved it as a curiosity. The occurrence of this one stone, where every other particle of matter is calcareous, certainly is very puzzling. The island has scarcely ever been visited, nor is it probable that a ship had been wrecked there. From the absence of any better explanation, I came to the conclusion that it must have come there entangled in the roots of some large tree: when, however, I considered the great distance from the nearest land, the combination of chances against a stone thus being entangled, the tree washed into the sea, floated so far, then landed safely, and the stone finally so embedded as to allow of its discovery, I was almost ashamed of imagining a means of transport so improbable. It was therefore with great interest that I found Chamisso,* the justly distinguished naturalist who accompanied Kotzebue, stating that the inhabitants of the Radack Archipelago,

* Kotzebue's first voyage, vol. iii., p. 155. It is said, "The sea throws up on the reefs of Radack the trunks of northern firs (!) and trees of the torrid zone (palms, bamboos). It provides the inhabitants not only with timber for boats, but it also brings them in wrecks of European ships, the iron which they want."—"They receive, in a similar manner, another treasure, hard stones fit for whetting. They are sought for in the roots and hollows of the trees which the sea throws up."

a group of lagoon islands in the midst of the Pacific, obtained stones for sharpening their instruments by searching the roots of trees which are cast up on the beach. It will be evident that this must have happened several times, since laws have been established that such stones belong to the chief, and a punishment is inflicted on any one who attempts to defraud him of this right. When the isolated position of these small islands in the midst of a vast ocean—their great distance from any land excepting that of coral formation, a fact well attested by the value which the inhabitants, who are such bold navigators, attach to a stone of any kind,* —and the slowness of the currents of the open sea are all considered, the occurrence of pebbles thus transported does appear wonderful. Stones may often be thus transported; and if the island on which they are stranded is constructed of any other substance besides coral, they would scarcely attract attention, and their origin at least would never have been guessed. Moreover this agency may long escape discovery from the probability of trees, especially those loaded with stones, floating beneath the surface. In the channels of Tierra del Fuego large quantities of drift timber are cast upon the beach, yet it is extremely rare to meet a tree swimming on the water. It is easy to conceive that waterlogged wood might be transported, when floating close to the bottom, and occasionally even just touching it. The knowledge of any result which (with sufficient time allowed) can be produced by causes, though appearing infinitely improbable, is valuable to the geologist, for he by his creed deals with centuries and thousands of years as others do with minutes. If a few isolated stones are discovered in a mass of fine sedimentary strata, it cannot, after the above facts, be considered as very improbable that they may have been drifted there by the floating timber of a former epoch.

During another day I visited Horsburg and West Island.

* Some natives carried by Kotzebue to Kamtschatka collected stones among other valuable articles to take back to their country.

In the latter, the vegetation was perhaps more luxuriant than in any other part. The cocoa-nut trees generally grow separate, but here the young ones flourished beneath their tall parents, and formed with their long and curved fronds the most shady arbours. Those alone who have tried it know how delicious it is to be seated in such shade, and drink the cool pleasant fluid of the cocoa-nut, which hangs in great bunches close by. In this island there is a large bay or little lagoon, composed of the finest white sand: it is quite level, and is only covered by the tide at high water; from this large bay smaller creeks penetrated the surrounding woods. To see a field of glittering sand, representing water, and around the border of which the cocoa-nut trees extended their tall and waving trunks, formed a singular and very pretty view.

I will now briefly mention a few zoological observations which I made during our stay at these islands. I have before alluded to a crab which lives on the cocoa-nuts; it is very common on all parts of the dry land, and grows to a monstrous size. It is closely allied or identical with *Birgos latro*. This crab has its front pair of legs terminated by very strong and heavy pincers, and the last pair by others which are narrow and weak. It would at first be thought quite impossible for a crab to open a strong cocoa-nut covered with the husk; but Mr. Liesk assures me he has repeatedly seen the operation effected. The crab begins by tearing the husk, fibre by fibre, and always from that end under which the three eye holes are situated; when this is completed, the crab commences hammering with its heavy claws on one of these eye holes, till an opening is made. Then turning round its body, by the aid of its posterior and narrow pair of pincers, it extracts the white albuminous substance. I think this is as curious a case of instinct as ever I heard of, and likewise of adaptation in structure between two objects apparently so remote from each other in the scheme of nature as a crab and a cocoa-nut tree. The Birgos is diurnal in its habits, but every night it is said to pay

a visit to the sea, no doubt for the purpose of moistening its branchiæ. The young are likewise hatched, and live for some time, on the coast. These crabs inhabit deep burrows, which they excavate beneath the roots of trees; and here they accumulate surprising quantities of the picked fibres of the cocoa-nut husk, on which they rest as on a bed. The Malays sometimes take advantage of their labour by collecting the course fibrous substance and using it as junk. These crabs are very good to eat; moreover under the tail of the larger ones there is a great mass of fat, which when melted sometimes yields as much as a quart bottle full of limpid oil. It has been stated by some authors that the *Birgos latro* crawls up the *cocoa-nut trees* for the purpose of stealing the nuts: I very much doubt the possibility of this; but with the *Pandanus** the task would be very much easier. I understood from Mr. Liesk that on these islands the Birgos lives only on the nuts which fall to the ground.

I was a good deal surprised by finding two species of coral of the genus Millepora, possessed of the property of stinging. The stony branches or plates when taken fresh from the water have a harsh feel and are not slimy, although possessing a strong and disagreeable odour. The stinging property seems to vary within certain limits in different specimens: when a piece was pressed or rubbed on the tender skin of the face or arm, a pricking sensation was generally caused, which came on after the interval of a second, and lasted only for a short time. One day, however, by merely touching my face with one of the branches the pain was instantaneous; it increased as usual after a few seconds, and remaining sharp for some minutes, was perceptible for half an hour afterwards. The sensation was as bad as that from a nettle, but more like that caused by the Portuguese man-of-war (*Physalia*). Little red spots were produced on the tender skin of the arm, which appeared as if they would have formed watery pustules, but did not. The circumstance of this sting-

* See Proceedings of Zoological Society, 1832, p. 17.

ing property is not new, though it has scarcely been sufficiently remarked on. M. Quoy* mentions it, and I have heard of stinging corals in the West Indies. In the East Indian sea a stinging sea-weed also is found.

There was another and quite distinct kind of coral, which was remarkable from the change of colour, which it underwent shortly after death; when alive it was of a honey-yellow, but some hours after being taken out of water, it became as black as ink. I may just mention, as partly connected with the above subjects, that there are here two species of fish, of the genus Sparus, which exclusively feed on coral. Both are coloured of a splendid bluish-green, one living invariably in the lagoon, and the other amongst the outer breakers. Mr. Liesk assured us that he had repeatedly seen whole shoals grazing with their strong bony jaws on the tops of the coral branches.† I opened the intestines of several, and found them distended with a yellowish calcareous matter. These fish, together with the lithophagous shells and nereidous animals, which perforate every block of dead coral, must be very efficient agents in producing the finest kind of mud, and this, when derived from such materials, appears to be the same with chalk.

April 12th.—In the morning, we stood out of the Lagoon. I am glad we have visited these islands: such formations surely rank high amongst the wonderful objects of this world. It is not a wonder, which at first strikes the eye of the body, but rather, after reflection, the eye of reason. We feel surprised, when travellers relate accounts of the vast extent of certain ancient ruins; but how utterly insignificant are the greatest of these, when compared to the pile of stone here accumulated by the work of various minute animals. Throughout the whole group of islands, every single atom,‡

* Freycinet's Voyage, vol. i., p. 597.

† It has sometimes been thought (*vide* Quoy in Freycinet's Voyage), that coral-eating fish were poisonous; such certainly was not the case with these Spari.

‡ I exclude, of course, the soil which has been brought here in vessels

even from the smallest particle to large fragments of rock, bears the stamp of having been subjected to the power of organic arrangement. Captain FitzRoy, at the distance of but little more than a mile from the shore, sounded with a line, 7200 feet long, and found no bottom. This island is, therefore, a lofty submarine mountain, which has a greater inclination than even those of volcanic origin on the land. I will now give a sketch* of the general results at which I have arrived, respecting the origin of the various classes of reefs, which occur scattered over such large spaces of the intertropical seas.

The first consideration to attend to, is, that every observation leads to the conclusion that those lamelliform corals, which are the efficient agents in forming a reef, cannot live at any considerable depth. As far as I have personally seen, I judge of this from carefully examining the impressions on the soundings, which were taken by Captain FitzRoy at Keeling Island, close outside the breakers, and from some others which I obtained at the Mauritius. At a depth under ten fathoms, the arming came up as clean as if it had been dropped on a carpet of thick turf; but as the depth increased, the particles of sand brought up became more and more numerous, until, at last, it was evident the bottom consisted of a smooth layer of calcareous sand, interrupted only at intervals by shelves, composed probably of dead coral rock. To carry on the analogy, the blades of grass grew thinner and thinner, till, at last, the soil was so sterile, that nothing sprung from it.

As long as no facts, beyond those relating to the structure of lagoon islands were known, so as to establish some more comprehensive theory, the belief that corals constructed their habitations, or, speaking more correctly, their skeletons, on the circular crests of submarine craters, was

from Malacca and Java, and the small fragments of pumice, drifted here, together with the seeds of East Indian plants. The one block of greenstone, moreover, on the Northern Lagoon must be excepted.

* This sketch was read before the Geological Society, May, 1837.

both ingenious and very plausible. Yet the sinuous margin of some, as in the Radack Islands of Kotzebue, one of which is fifty-two miles long, by twenty broad, and the narrowness of others, as in Bow Island (of which there is a chart on a large scale, forming part of the admirable labours of Captain Beechey), must have startled every one who considered this subject.

The very general surprise of all those who have beheld lagoon islands, has perhaps been one chief cause why other reefs, of an equally curious structure have been almost overlooked:* I allude to the encircling reefs. We will take, as an instance, Vanikoro, celebrated on account of the shipwreck of La Peyrouse. The reef there runs at the distance of nearly two, and in some parts three miles from the shore, and is separated from it by a channel having a general depth between thirty and forty fathoms, and, in one part, no less than fifty, or three hundred feet. Externally, the reef rises from an ocean profoundly deep. Can any thing be more singular than this structure? It is analogous to that of a lagoon, but with an island standing, like a picture in its frame, in the middle. A fringe of low alluvial land in these cases generally surrounds the base of the mountains; this, covered by the most beautiful productions of a tropical land, backed by the abrupt mountains and fronted by a lake of smooth water, only separated from the dark waves of the ocean by a line of breakers, form the elements of the beautiful scenery of Tahiti—so well called the Queen of Islands. We cannot suppose these encircling reefs are based on an external crater, for the central mass sometimes consists of primary rock, or on any accumulation of sedimentary deposits, for the reefs follow indifferently the island itself, or its submarine prolongation. Of this latter case there is a grand instance

* Mr. De la Beche, however, seems to have been fully aware of the difficulty. He says, "there are certain situations, where coral reefs run, as it were, in a line with the coast, but separated from it by deep water, which would seem to require a different explanation." — *Geological Manual*, p. 142.

in New Caledonia, where the reefs extend no less than 140 miles beyond the island.

The great Barrier which fronts the N.E. coast of Australia, forms a third class of reef. It is described by Flinders as having a length of nearly one thousand miles, and as running parallel to the shore, at a distance of between twenty and thrty miles from it, and, in some parts, even of fifty and seventy. The great arm of the sea thus included, has a usual depth of between ten and twenty fathoms, but this increases towards one end to forty and even sixty. This probably is both the grandest and most extraordinary reef now existing in any part of the world.

It must be observed, that the reef itself in the three classes, namely, lagoon, encircling, and barrier, agrees in structure, even in the most minute details: but these I have not space here even to allude to. The difference entirely lies in the absence or presence of neighbouring land, and the relative position which the reefs bear to it. In the two last-mentioned classes, there is one difficulty in undertaking their origin, which must be pointed out. Since the time of Dampier it has been remarked, that high land and deep seas go together. Now when we see a number of mountainous islands coming abruptly down to the sea-shore, we must suppose the strata of which they are composed, are continued with nearly the same inclination beneath the water. But, in such cases, where the reef is distant several miles from the coast, it will be evident upon a little consideration, that a line drawn perpendicularly from its outer edge down to the solid rock on which the reef must be based, very far exceeds that small limit at which the efficient lamelliform corals exist.

In some parts of the sea, as we shall hereafter mention, reefs do occur which fringe rather than encircle islands—the distance from the shore being so small, where the inclination of the land is great, that there is no difficulty in understand- the growth of the coral. Even in these "fringing" reefs, as I shall call them in contradistinction to the "encircling," the

reef is not attached quite close to the shore. This appears to be the result of two causes: namely, first, that the water immediately adjoining the beach is rendered turbid by the surf, and therefore injurious to all zoophytes; and, secondly, that the larger and efficient kinds only flourish on the outer edge amidst the breakers of the open sea. The shallow space between the skirting reef and the shore has, however, a very different character from the deep channel, similarly situated with respect to those of the encircling order.

Having thus specified the several kinds of reefs, which differ in their forms and relative position with regard to the neighbouring land, but which are most closely similar in all other respects (as I could show if I had space), it will, I think, be allowed that no explanation can be satisfactory which does not include the whole series. The theory which I would offer, is simply, that as the land with the attached reefs subsides very gradually from the action of subterranean causes, the coral-building polypi soon raise again their solid masses to the level of the water: but not so with the land; each inch lost is irreclaimably gone;—as the whole gradually sinks, the water gains foot by foot on the shore, till the last and highest peak is finally submerged.

Before I explain this view more in detail, I must enter on a few considerations, which render such changes of level not improbable. Indeed, the simple fact of a large portion of the continent of South America, still rising under our eyes, and abounding with proofs of similar elevations on a grander scale during the recent period, takes away any excessive improbability of a movement similar in kind, but in an opposite direction. Mr. Lyell, who first suggested the idea of a general subsidence with reference to coral reefs, has remarked that the existence of so small a portion of land in the Pacific, where so many causes both aqueous and igneous tend to its production, renders such sinking of the foundation probable. There is, however, another argument of much greater weight, which may be inferred from the inconsiderable depth at which corals grow. We see large extents

of ocean, of more than a thousand miles in one direction and several hundreds in another, scattered over with islands, none of which rise to a greater height than that to which waves can throw fragments, or the wind heap up sand. Now if we leave out of the question subsidence, the foundation on which these reefs are built, must in every case come to the surface within that small limit (we may say twenty fathoms) at which corals can live. This conclusion is so extremely improbable that it may at once be rejected: for in what country can there be found a broad and grand range of mountains of the same height within a hundred and twenty feet? But on the idea of subsidence, the case is at once clear: as each point, one after the other according to its altitude, was submerged, the coral grew upwards, and formed the many islets now standing at one level.

Having endeavoured on general grounds not only to remove any extreme degree of improbability in the belief of a general subsidence, but likewise to show that it is almost necessary to account for the existence of a vast number of reefs on one level, we will now see how far the same idea will apply to the peculiar configuration in the several classes. Let us imagine an island merely fringed by reefs extending to a short distance from the shore; in which case, as we have before remarked, there is no difficulty in understanding their structure. Now let this island subside by a series of movements of extreme slowness, the coral at each interval growing up to the surface. Without the aid of sections it is not very easy to follow out the result, but a little reflection will show that a reef encircling the shore at a greater or less distance, according to the amount of subsidence, would be produced. If we suppose the sinking to continue, the encircled island must, by the submergence of the central land but upward growth of the ring of coral, be converted into a lagoon island. If we take a section of some encircled island on a true scale, as for instance Gambier, which has been so well described by Captain Beechey, we shall not find

the amount of movement very great, which would be necessary to change a well-characterized encircling reef, into as characteristic a lagoon island.

It will at once be evident that a coral reef, closely skirting the shore of a continent, would, in like manner after each subsidence, rise to the surface; the water, however, always encroaching on the land. Would not a barrier reef necessarily be produced, similar to the one extending parallel to the coast of Australia? It is indeed but uncoiling one of those reefs which encircle at a distance so many islands.

Thus the three great classes of reef, lagoon, encircling, and barrier, are connected by one theory. It will perhaps be remarked, if this be true, there ought to exist every intermediate form between a closely-encircled and a lagoon island. Such forms actually occur in various parts of the ocean: we have one, two, or more islands encircled in one reef; and of these some are of small proportional size to the area enclosed by the coral formation; so that a series of charts might be given, showing a gradation of character between the two classes. In New Caledonia, where the double line of reef projects 140 miles beyond the island, we may imagine we see this change in progress. At the northern extremity, reefs occur, some of which are of the encircling kind, and others almost with the character of true lagoon islands. The line of reef which fronts the whole west coast of this great island, has by some been called a barrier. It is four hundred miles long; and may be said thus to form a link between an ordinary encircling reef and the great Australian barrier.

I should perhaps have entered before into the consideration of one apparent difficulty in the origin of lagoon islands. It may be said, granting the theory of subsidence, a mere circular disc of coral would be formed, and not a cup-shaped mass. In the first place, even in reefs closely fringing the land (as before remarked), the corals do not grow on the shore itself, but leave a shallow channel. Secondly, the strong and vigorous species which

alone build a solid reef, are never found within the lagoon; they only flourish amidst the foam of the never-tiring breakers. Nevertheless, the more delicate corals, though checked by several causes, such as strong tides and deposits of sand, do constantly tend to fill up the lagoon; but the process must become slower and slower, as the water in the shallow expanse is rendered subject to accidental impurities. A curious instance of this happened at Keeling Island, where a heavy tropical storm of rain killed nearly all the fish. When the coral at last has filled up the lagoon to the height of lowest water at spring-tides, which is the extreme limit possible,—how, afterwards, is the work to be completed? There is no high land whence sediment can be poured down; and the dark-blue colour of the ocean bespeaks its purity. The wind, carrying calcareous dust from the outer coast, is the only agent which can finally convert the lagoon island into solid land, and how slow must this process be!

Subsidence of the land must always be most difficult to detect, excepting in countries long civilized,—for the movement itself tends to conceal all evidence of it. Nevertheless, at Keeling Island, tolerably conclusive evidence of such movement could be observed. On every side of the lagoon, in which the water is as tranquil as in the most sheltered lake, old cocoa-nut trees were undermined and falling. Captain FitzRoy likewise pointed out to me on the beach the foundation-posts of a storehouse, which the inhabitants said had stood, seven years before, just above high-water mark, but now was daily washed by the tide. Upon asking the people whether they ever experienced earthquakes, they said, that lately the island had been shaken by a very bad one; and that they remembered two others during the last ten years. I no longer doubted concerning the cause which made the trees fall, and the storehouse to be washed by the daily tide.

At Vanikoro, the encircled island already mentioned, I gathered from Captain Dillon's account, that the alluvial

land at the foot of the mountain was very small in quantity, the channel extremely deep, and the islets on the reef itself, which result from the gradual accumulation of fragments, singularly few in number; all of which, together with the wall-like structure of the reef both inside as well as outside, indicated to my mind, that, without doubt, the movements of subsidence had lately been rapid. At the end of the chapter, it is stated that this island is shaken by earthquakes of extreme violence.

I may here mention a circumstance, which to my mind had the same weight as positive evidence, though bearing on another part of the question. M. Quoy, when discussing in general terms the nature of coral reefs, gives a description which is applicable only to those which, *skirting* the shore, do not require a foundation at any greater depth than that from which the coral-building polypi can spring. I was at first astonished at this, as I knew he had crossed both the Pacific and Indian oceans, and must, as I thought, have seen the class of widely-encircling reefs, which indicate a subsiding land. He subsequently mentions several islands as instances of his description of the general structure; by a singular chance, the whole can be shown, by his own words, in different parts of his account, to have been recently elevated. Therefore, that which appeared so adverse to the theory, became as strong in its confirmation.

Continental elevations, as observed in South America and other parts, seem to act over wide areas with a very uniform force; we may therefore suppose that continental subsidences act in a nearly similar manner. On this assumption, and taking on the one hand, lagoon islands, encircling and barrier reefs, as indications of subsidence; and on the other, raised shells and corals, together with mere skirting reefs, as our proof of elevation, we may test the truth of the theory,—that their configuration has been determined by the kind of subterranean movement,—by observing whether any uniform results can be obtained. I think it can be shown that such is the case in a very

remarkable degree; and that certain laws may be inferred from the examination, of far more importance than the mere explanation of the origin of the circular or other kinds of reef.

If there had been space, I should have made a few general remarks, before entering into any detail. I may, however, just notice the remarkable absence of the reef-building polypi over certain wide areas within the tropical sea: for instance, on the whole west coast of America, and, as I believe, of Africa (?), and round the eastern islands in the Atlantic ocean. Although certain species of lamelliform zoophytes are found on the shores of the latter islands, and though calcareous matter is abundant to excess, yet reefs are never formed. It would appear that the effective species do not occur there; of which circumstance I apprehend no explanation can be given, any more than why it has been ordained that certain plants, as heaths, should be absent from the New World, although so common in the Old.

Without entering into any minute geographical details, I must observe, that the usual direction of the island groups in the central parts of the Pacific, is N.W. and S.E. This must be noticed, because subterranean disturbances are known to follow the coast lines of the land. Commencing on the shores of America, there are abundant proofs that the greater part has been elevated within the recent period, but as coral reefs do not occur there, it is not immediately connected with our present subject. Immediately adjoining the continent there is an extent of ocean remarkably free from islands, and where of course there exists no possible indication of any change of level. We then come to a N.W. by W. line dividing the open sea from one strewed with lagoon islands, and including the two beautiful groups of encircled islands the Society and Georgian Archipelagoes. This great band having a length of more than four thousand miles by six hundred broad must, according to our view, be an area of subsidence. We will at present for convenience sake

pass over the space of ocean immediately adjoining it, and proceed to the chain of islands including the New Hebrides, Solomon, and New Ireland. Any one who examines the charts of the separate islands in the Pacific, engraved on a large scale, will be struck with the absence of all distant or encircling reefs round these groups: yet it is known that coral occurs abundantly close in shore. Here, then, according to the theory, there are no proofs of subsidence; and in conformity to this we find in the works of Forster, Lesson, Labillardière, Quoy, and Bennett, constant allusion to the masses of elevated coral. These islands form, therefore, a well-determined band of elevation: between it and the great area of subsidence first mentioned there is a broad space of sea irregularly scattered with islets of all classes; some with proofs of recent elevation and merely fringed by reefs; others encircled; and some lagoon islands. One of the latter is described by Captain Cook as a grand circle of breakers without a single spot of land; in this case we may believe that an ordinary lagoon island has been recently submerged. On the other hand, there are proofs of other lagoon islands having been lifted up several yards above the level of the sea, but which still retain a pool of salt water in their centres. These facts show an irregular action in the subterranean forces; and when we remember that the space lies directly between the well-marked area of elevation and the enormous one of subsidence, an alternate and irregular movement seems almost probable.

To the westward of the New Hebrides line of elevation we have New Caledonia, and the space included between it and the Australian barrier, which Flinders, on account of the number of reefs, proposed to call the Corallian Sea. It is bounded on two sides by the grandest and most extraordinary reefs in the world, and is likewise terminated to the northward by the coast of Louisiade,—most dangerous on account of its distant reefs. This, then, according to our theory, is an area of subsidence. I may here remark, that as the Barrier is supposed to be produced by the subsidence

of the coast of the mainland, it may be expected that any outlying islands would have formed lagoon islands. Now Bligh and others distinctly state that some of the islands there are precisely similar to the well-known lagoon islands in the Pacific; there are also encircled islands, so that the three classes supposed to be produced by the same movement are there found in juxtaposition; as likewise happens, but in a less evident manner, at New Caledonia and in the Society Archipelago.

The New Hebrides line of islands, may be observed to bend abruptly at New Britain, thence to run nearly east and west; and, lastly, to resume its former north-west direction in Sumatra and the peninsula of Malacca. The figure may be compared to the letter S laid obliquely, but the line is often double. We have shown that the southern part, as far north as New Ireland, abounds with proofs of elevation, so is it with the rest. Since the time of Bougainville every voyager adduces some fresh instance of such changes throughout a great part of the East Indian archipelago. I may specify New Guinea, Wageeoo, Ceram, Timor, Java, and Sumatra. Coral reefs are abundant in the greater part of these seas, but they merely skirt the shores. In the same manner as we have followed the curved line of elevation, so may we that of subsidence. At Keeling Island, I have already mentioned that there exist proofs of the latter movement: and it is a very interesting circumstance, that during the last earthquake, by which that island was affected, Sumatra, though distant nearly 600 miles, was violently shaken. Bearing in mind that there is evidence of recent elevation on the coast of the latter, one is strongly tempted to believe that as one end of the lever goes up, the other goes down: that as the East Indian archipelago rises, the bottom of the neighbouring sea sinks and carries with it Keeling Island, which would have been submerged long ago in the depths of the ocean, had it not been for the wonderful labours of the reef-building polypi.

As I have remarked, the islands in this great archipelago are only skirted with reefs; and it appears from the state-

ments of those who have visited them, as well as from an examination of the charts, that lagoon islands are not found there. This in itself is remarkable, but it becomes far more so when it is known, that according to all accounts (and distinctly stated by Mr. De la Beche*) they are likewise absent in the West Indian sea, where coral is most abundant: now every one is aware of the numerous proofs of recent elevation in most parts of that archipelago. Again, Ehrenberg has observed that lagoon islands do not occur in the Red Sea: in Lyell's Geology, and in the Geographical Journal, proofs are given of recent elevation on the shores of a large part of that sea. Excepting on the theory of the form of reefs being determined by the kind of movement to which they have been subjected; it is a most anomalous circumstance, and which has never been attempted to be solved, that the lagoon structure being universal and considered as characteristic in certain parts of the ocean, should be entirely absent in others of equal extent.

I may here also just recal to mind the cases of skirting reefs mentioned by M. Quoy (to which number several others might be added), where proofs of elevation occurred. Some general law must determine the marked difference between reefs merely skirting the shore, and others rising from a deep ocean in the form of distant rings. We have endeavoured to show that with a subsiding movement, the first and simple class must necessarily pass into the second, and more remarkable structure.

To proceed with our examination: to the westward of the prolongation of the line of subsidence, of which Keeling Island is the index, we have an area of elevation. For on the northern end of Ceylon and on the eastern shores of India, elevated shells and corals, such as now exist in the neighbouring sea, have been observed. Again in the middle of the Indian ocean, the Laccadive, Maldive, and Chagos line of atolls or lagoons show a line of subsidence. The

* Geological Manual, p. 141.

best characterized of these, namely, the Maldive islands, extend in length for 480 miles, with an average breadth of sixty. These atolls agree in most respects with the lagoons of the Pacific; they differ, however, in several of them being crowded together—such little groups being separated from other groups by profoundly deep channels. Now if we look in a chart, at the prolongation of the reef towards the northern end of New Caledonia, and then complete the work of subsidence, so as to continue producing the same results; we should have the original reef broken up into many patches; each of which, from the vigorous growth of coral on the outside, would have a constant tendency to assume a rounded form. Every accidental break in the continuity of the first line would determine a fresh circle. In the case, therefore, of the Low or Dangerous Archipelago in the Pacific, I believe that the lagoon islands were moulded round the flanks of so many distinct islands; but in the Maldives, that one single mountainous island, bordered by reefs, and very nearly of the same actual figure and dimensions with New Caledonia, formerly occupied that part of the ocean.

Lastly, to the extreme westward, the coast of Africa is closely skirted by coral reefs, and according to facts stated in Captain Owen's voyage, has probably been uplifted within a recent period. The same remark applies to the northern part of Madagascar, and, judging from the reefs likewise at the Seychelles, situated on the submarine prolongation of that great island. Between these two, N.N.E. and S.S.W. lines of elevation, some lagoon and widely-encircled islands indicate a band of subsidence.

When we consider the absence both of widely-encircling reefs and lagoon islands in the several archipelagoes and wide areas, where there are proofs of elevations; and on the other hand the converse case of the absence of such proof where reefs of those classes do occur; together with the juxtaposition of the different kinds produced by movements of the same order, and the symmetry of the whole, I think it will be difficult (even independently of the explanation it

offers of the peculiar configuration of each class) to deny a great probability to this theory. Its importance, if true, is evident; because we get at one glance an insight into the system by which the surface of the land has been broken up, in a manner somewhat similar, but certainly far less perfect, to what a geologist would have done who had lived his ten thousand years, and kept a record of the passing changes. We see the law almost established, that linear areas of great extent undergo movements of an astonishing uniformity, and that the bands of elevation and subsidence alternate. Such phenomena at once impress the mind with the idea of a fluid most gradually propelled onwards, from beneath one part of the solid crust to another.

I cannot at present do more than allude to some of the results which may be deduced from these views. If we examine the points of eruption over the Pacific and Indian oceans, we shall find that all the *active volcanoes* occur within *the areas of elevation.* (The Asiatic band must be excepted; inasmuch as we are entirely in want of information of all kinds respecting it.) On the other hand, in the great spaces supposed to be now subsiding, between the Radack and Dangerous Archipelagoes, in the Corallian sea, and among the atolls which front the west coast of India, not one occurs. If we look at the changes of level as a consequence of the propulsion of fluid matter beneath the crust, as before suggested, then the area to which the force is directed might be expected to yield more readily than that whence it was gradually retiring. I am the more convinced that the above law is true, because, if we look to other parts of the world, proofs of recent elevation almost invariably occur, where there are active vents: I may instance the West Indies, the Cape de Verds, Canary Islands, southern Italy, Sicily, and other places. But in answer to this, those geologists, who, judging from the history of the isolated volcanic mounds of Europe, were inclined to believe that the level of the ground was constantly oscillating up and down, might maintain that on these same areas, the amount of subsidence had been equal to that

of elevation, but that we possessed no means of knowing it. I conceive it is by eliminating this source of doubt, that the alternate bands of opposite movement, deduced from the configuration of the reefs, directly bear on this law. I need not do more than simply state, that we thus obtain (if the view is correct) a means of forming some judgment of the prevailing movements, during the formation of even the oldest series, where volcanic rocks occur interstratified with sedimentary deposits.

Any thing which throws light on the movements of the ground is well worthy of consideration; and the history of coral reefs may, in another manner, elucidate such changes in the older formations. As there is every reason to believe that the lamelliform corals grow only abundantly at a small depth, we may feel sure, where a great thickness of coral limestone occurs, that the reefs on which the zoophytes flourished, must have been sinking. Until we are enabled to judge by some means what were the prevailing movements at different epochs, it will scarcely ever be possible to speculate with any safety on the circumstances under which the complicated European formations, composed of such different materials and in such different states, were accumulated.

Nor can I quite pass over the probability of the above views illustrating those admirable laws first brought forward by Mr. Lyell,—of the geographical distribution of plants and animals, as consequent on geological changes. M. Lesson has remarked on the singular uniformity* of the Indio-Polynesian Flora throughout the immense area of the Pacific;—the dispersion of forms having been directed against the course of the trade-wind. If we believe that lagoon islands, those monuments raised by infinite numbers of minute architects, record the former existence of an archipelago or continent in the central part of Polynesia, whence the

* Perhaps this is stated rather too strongly; but M. Lesson, of course, had grounds for his assertion.

germs could be disseminated, the problem is rendered far more intelligible. Again, if the theory should hereafter be so far established, as to allow us to pronounce that certain districts fall within areas either of elevation or subsidence, it will directly bear upon that most mysterious question,—whether the series of organized beings peculiar to some isolated points, are the last remnants of a former population, or the first creatures of a new one springing into existence.

Briefly to recapitulate. In the first place, reefs are formed around islands, or on the coast of the mainland, at that limited depth at which the efficient classes of zoophytes can live; and where the sea is shallow, irregular patches may likewise be produced. Afterwards from the effects of a series of small subsidences, encircling reefs, grand barriers, or lagoon islands, are mere modifications of one necessary result. Secondly, it can be shown on the above views, that the intertropical ocean, throughout more than a hemisphere, may be divided into linear and parallel bands, of which the alternate ones have undergone, within a recent period, the opposite movements of elevation and subsidence. Thirdly, that the points of eruption seem invariably to fall within areas subject to a propulsion from below. The traveller who is an eyewitness of some great and overwhelming earthquake, at one moment of time loses all former associations of the land being the type of solidity, so will the geologist, if he believe in these oscillations of level (the deeply-seated origin of which is betrayed by their forms and vast dimensions), perhaps be more deeply impressed with the never-ceasing mutability of the crust of this our World.

CHAPTER XXIII.

Mauritius, beautiful appearance—Hindoos—Cape of Goo Hope—St. Helena—Geology—History of changes in vegetation, probable cause of extinction of land-shells—Ascension—Green Hill—Curious incrustations of calcareons matter on tidal rocks—Bahia—Brazil—Splendour of tropical scenery—Pernambuco—Singular reef—Azores—Supposed crater—Hints to collectors—Retrospect of the most impressive parts of the voyage.

MAURITIUS TO ENGLAND.

April 29th.—In the morning we passed round the northern extremity of the Isle of France. From this point of view the aspect of the island equalled the expectations raised by the many well-known descriptions of its beautiful scenery. The sloping plain of the Pamplemousses, scattered over with houses, and coloured bright green from the large fields of sugar-cane, composed the foreground. The brilliancy of the green was the more remarkable, because it is a colour which generally is only conspicuous from a very short distance. Towards the centre of the island, groups of wooded mountains rose out of this highly-cultivated plain; their summits, as so commonly happens with ancient volcanic rocks, being jagged into the sharpest points. Masses of white clouds were collected around their pinnacles, as if for the sake of pleasing the stranger's eye. The whole island, with its sloping border and central mountains, was adorned with an air of perfect elegance: the scenery, if I may use such an expression, appeared to the senses harmonious.

I spent the greater part of the next day in walking about the town, and visiting different people. The town is of considerable size, and is said to contain 20,000 inhabitants; the streets are very clean and regular. Although the island has been so many years under the English government, the general character of the place is quite French: Englishmen

speak to their servants in French, and the shops are all French; indeed I should think that Calais or Boulogne was much more Anglefied. There is a very pretty little theatre, in which operas are excellently performed, and are much preferred by the inhabitants to plays. We were also surprised at seeing large booksellers' shops, with well-stored shelves;—music and reading bespeak our approach to the old world of civilization; for in truth both Australia and America may be considered as new worlds.

One of the most interesting spectacles in Port Louis, is to observe the various races of men which may be met in walking the streets. Convicts from India are banished here for life; at present there are about 800, and they are employed in various public works. Before seeing these people, I had no idea that the inhabitants of India were such noble-looking figures. Their skin is extremely dark, and many of the older men had large mustaches and beards of a snow-white colour; this, together with the fire of their expressions, gave them quite an imposing aspect. The greater number have been banished for murder and the worst crimes; others for causes which can scarcely be considered as moral faults, such as for not obeying, from superstitious motives, the English laws. These men are generally quiet and well-conducted; from their outward conduct, their cleanliness and faithful observance of their strange religious enactments, it was impossible to look at them with the same eyes as on our wretched convicts in New South Wales. Besides these prisoners, large numbers of free people are yearly imported from India: for the planters were afraid that the negroes, when emancipated, would not work. From these causes the Indian population is here very considerable.

May 1st.—Sunday. I took a quiet walk along the sea-coast to the northward of the town. The plain in that part is quite uncultivated; it consists of a field of black lava, smoothed over with coarse grass and bushes, the latter being chiefly mimosas. Captain FitzRoy, before arriving here, said he expected the island would have a character

intermediate between that of the Galapagos and Tahiti. This is a very exact comparison; but it will convey a definite idea to few, excepting to those who were on board the Beagle. It is a very pleasant country, but it has not the charms of Tahiti, or the grandeur of a Brazilian landscape.

The next day I ascended La Pouce, a mountain so called from a thumb-like projection, which rises close behind the town to a height of 2600 feet. M. Lesson, in the voyage of the Coquille, has stated, that the central plain of the island appeared like the basin of a grand crater, and that La Pouce and the other mountains once formed parts of a connected wall. From our elevated position we enjoyed an excellent view over this great mass of volcanic matter. The country on this side of the island appears pretty well cultivated, the whole being divided into fields, and studded with farm-houses. I was however assured, that of the whole land not more than half is yet in a productive state; if such is the case, considering the present great export of sugar, this island, at some future period when thickly peopled, will be of very great value. Since England has taken possession of it, a period of only twenty-five years, the export of sugar is said to have increased seventy-five fold.

One great cause of this prosperity is due to the excellent roads and means of communication throughout the island. At the present day, in the neighbouring Isle of Bourbon, which remains under the French government, the roads are in the same miserable state as they were only a few years past in this place. The Macadamizing art has, perhaps, been of even greater advantage to the colonies, than to the mother country. Although the French residents must have largely profited by the increased prosperity of their island, yet the English government is far from popular. It is unfortunate that there appears to exist scarcely any intercourse among the higher orders of French and English.

May 3d.—In the evening Captain Lloyd, the Surveyor-general, so well known from his examination of the Isthmus of Panama, invited Mr. Stokes and myself to his country-

house, which is situated on the edge of Wilheim plains, and about six miles from the port. We staid at this delightful place two days: being elevated nearly 800 feet above the sea, the air was pleasantly cool and fresh, and on every side there were delightful walks. Close by there is a grand ravine, which is worn to a depth of about 500 feet through the slightly inclined streams of lava which have flowed from the central platform.

5TH.—Captain Lloyd took us to the Rivière Noire, which is several miles to the southward, in order that I might examine some rocks of elevated coral. We passed through pleasant gardens, and fine fields of sugar-cane growing amidst huge blocks of lava. The roads were bordered by hedges of mimosa, and near many of the houses there were avenues of the mango. Some of the views, where the peaked hills and the cultivated farms were seen together, were exceedingly picturesque; and we were constantly tempted to exclaim, "How pleasant it would be to pass one's life in such a quiet abode!" Captain Lloyd possessed an elephant; he sent it half way with us on the road, that we might enjoy a ride in true Indian fashion. I should think, as is commonly said to be the case, that the motion must be fatiguing for a long journey. The circumstance which surprised me most, was the quite noiseless step; a ride on so wonderful an animal was extremely interesting. This elephant is the only one at present on the island; but it is said others will be sent for.

MAY 9TH.—We sailed from Port Louis, on our way to the Cape of Good Hope, and on the evening of the 31st anchored in Simon's Bay. The little town offers but a cheerless aspect to a stranger's eye. About a couple of hundred, square, whitewashed houses, with scarcely a single tree in the neighbourhood, and very few gardens, are scattered along the beach, at the foot of a lofty, steep, bare wall, of horizontally-stratified sandstone.

The next day I set out for Cape Town, which is twenty miles distant. Both towns are situated within the head-

lands, but at the opposite extremities of a range of mountains, which extending parallel to the mainland, is joined to it by a low sandy flat. The road skirted the base of these mountains: for the first fourteen miles the country is very desert, and with the exception of the pleasure which the sight of an entirely new vegetation never fails to communicate, there was very little of interest. The view however of the mountains on the opposite side of the flat, brightened by the declining sun, was fine. Within seven miles of Cape Town, in the neighbourhood of Wynberg, a great improvement was visible, and here the country-houses of the more wealthy residents of the capital are situated. The numerous woods of young Scotch firs and stunted oak-trees form the chief attraction of this locality. There is, indeed, a great charm in shade and retirement, after the unconcealed bleakness of so open a country as this. The houses and plantations are backed by a grand wall of mountains, which gives the scene a degree of uncommon beauty. I arrived late in the evening in Cape Town, and had a good deal of difficulty in finding quarters. In the morning several ships from India had arrived at this great inn on the great highway of nations, and they had disgorged on shore a host of passengers, all longing to enjoy the delights of a temperate climate. There is only one good hotel, so that strangers generally live in boarding-houses;—a very uncomfortable fashion to which I was obliged to conform, although I was fortunate in my quarters.

In the morning I walked to a neighbouring hill to look at the town. It is laid out with the rectangular precision of a Spanish city: the streets are in good order, and Macadamized, and some of them have rows of trees on each side; the houses are all whitewashed, and look clean. In several trifling particulars the town had a foreign air, but it is daily becoming more English. There is scarcely a resident, excepting amongst the lowest order, who does not speak some English. In this facility in becoming Anglefied, there appears to exist a wide difference between this colony and

that of the Mauritius. It does not, however, arise from the popularity of the English; for the Dutch as well as the French, although they have profited to an immense degree by the English government, yet thoroughly dislike our whole nation.

All the fragments of the civilized world which we have visited in the southern hemisphere, appear to be flourishing: little embryo Englands are springing into life in many quarters. Although the Cape colony possesses only a moderately fertile country, it appears in a very prosperous condition. In one respect it suffers like New South Wales, namely, in the absence of water communication, and in the interior being separated from the coast by a high chain of mountains. This country does not possess coal; and there is no timber, excepting at a considerable distance. Hides, tallow, and wine are the chief exports, and latterly a considerable quantity of corn. The farmers are beginning also to pay attention to sheep-grazing,—a hint taken from Australia. It is no small triumph to Van Diemen's Land, that live sheep have been exported from a colony of thirty-three years standing, to this which was founded in 1651.

In Cape Town it is said that the present number of inhabitants is about 15,000, and in the whole colony, including coloured people, 200,000. Many different nations are here mingled together; the Europeans consist of Dutch, French, and English, and scattered people from other parts. The Malays, descendants of slaves brought from the East Indian archipelago, form a large body. They are a fine set of men, and can always be distinguished by a conical hat, like the roof of a circular thatched cottage, or by a red handkerchief on their heads. The number of negroes is not very great; and the Hottentots, the ill-treated aborigines of the country, are, I should think, in a still smaller proportion. The first object in Cape Town which strikes the eye of a stranger, is the number of bullock-waggons. Several times I saw eighteen, and I heard of twenty-four oxen being all yoked together in one team. Besides these, waggons with

four, six, and eight horses in hand, go trotting about the streets. I have as yet not mentioned the well-known Table Mountain. This great mass of horizontally stratified sandstone rises quite close behind the town to a height of 3500 feet: the upper part forms an absolute wall, often reaching into the region of the clouds. I should think so high a mountain, not forming part of an extensive platform, and yet being composed of horizontal strata, must be a rare phenomenon. It certainly gives the landscape a very peculiar, and from some points of view, a grand character.

June 4th.—I set out on a short excursion to see the neighbouring country, but I saw so very little, that I have scarcely any thing to say. I hired a couple of horses, and a young Hottentot groom to accompany me as a guide. He spoke English very well, and was most tidily dressed; he wore a long coat, beaver hat, and white gloves! The Hottentots, or Hodmadods as old Dampier calls them, to my eye look like partially bleached negroes. They are of a small stature, and have most singularly-formed heads and faces: the temple and cheek-bones project so much, that the whole face is hidden from a person standing in the same side position in which he would be enabled to see part of the features of a European. Their hair is very short and curly.

Our first day's ride was to the village of the Paarl, situated between thirty and forty miles to the N.E. of Cape Town. After leaving the neighbourhood of the town, where white houses stand as if picked out of a street and then by chance dropped on the open country, we had to cross a wide level sandy flat, totally unfit for cultivation. In the hopes of finding some hard materials for making a road, the sands had been bored along the whole line to the depth of forty feet, but without any success. Leaving the flat, we crossed a low undulating country, thinly clothed with a slight green vegetation. It was not the flowering season, but even at this time of the year there were some very pretty oxalises and mesembryanthemums, and on the sandy

spots fine tufts of heaths. There were also several beautiful little birds:—if a person could not find amusement in observing the animals and plants, there was very little else during the whole day to interest him: only here and there we passed a solitary farm-house.

Directly after arriving at the Paarl, I ascended a singular group of rounded granite hills, which rise close behind the village. From the summit I enjoyed a fine view of the line of mountains which I had to cross on the following morning. Their colours were gray or partly rusty red, and their outlines irregular, but far from picturesque: the general tint of the lower country was a pale brownish green, and the whole entirely destitute of woodland.* From the naked state of the mountains, seen likewise through a very clear atmosphere, I was reminded of Northern Chile; but the rocks there, possess at least a brilliant colouring. Immediately beneath the hill, the long village of the Paarl extended; all the houses were whitewashed, and appeared very comfortable; and there was not a single hovel. Each house had its garden and a few trees planted in straight rows; and there were many vineyards of considerable size, which at this time of year were destitute of leaves. The whole village possessed an air of quiet and respectable comfort.

June 5th.—After riding about three hours, we came near to the French Hoeck pass. This is so called from a number of emigrant protestant Frenchmen, who formerly settled in a flat valley at the foot of the mountain: it is one of the prettiest places I saw in my excursion. The pass is a considerable work, an inclined road having been cut along the steep side

* When the extreme southern part of Africa was first colonized, rhinoceroses (as I am informed by Dr. Andrew Smith) abounded over the whole of this district, and especially in the wooded valleys at the base of Table Mountain, where Cape Town now stands. I mention this in corroboration of the statement (p. 98), that a luxuriant vegetation is not at all necessary for the support of the larger quadrupeds. Having myself seen this district, which was formerly frequented by the huge rhinoceros, I am fully impressed with the truth of those views.

of the mountain: it forms one of the principal roads from the low land of the coast, to the mountains and great plains of the interior. We reached the foot of the mountains on the opposite, or S. E. side of the pass, a little after noon. Here, at the toll-bar, we found comfortable lodgings for the night. The surrounding mountains were destitute of trees, and even of brushwood; but they supported a scattered vegetation of rather a brighter green than usual: the quantity, however, of white siliceous sandstone, every where protruding itself uncovered, gave to the country a bleak and desolate aspect.

6TH.—My intention was to return by Sir Lowry Cole's pass, over the same chain of mountains as before, but a little further to the south. Following unfrequented paths, we crossed an irregular hilly country until we joined the other line of road. During the whole long day, I met scarcely a single person, and saw but few inhabited spots, or any number of cattle. A few roebucks were grazing on the sides of the hills, and some large dirty white vultures, like the condors of America, slowly wheeled over the place where probably some dead animal was lying. There was not even a tree to break the monotonous uniformity of the sandstone hills: I never saw a much less interesting country. At night we slept at the house of an English farmer; and at an early hour the next day we descended by Sir Lowry's pass, which, like that of the French Hoeck, has been cut, at a great expense, along the flank of a steep mountain. From the summit, there was a noble view of the whole of False Bay, and of the Table Mountain, and, immediately below, of the cultivated country of Hottentot Holland. The flat, covered with sand-dunes did not appear, when viewed from this height, of the tedious length which we found it before we reached in the evening Cape Town.

JUNE 18TH.—We put to sea, and, on the 29th, crossed the Tropic of Capricorn for the sixth and last time. On the 8th of July, we arrived off St. Helena. This island, the forbidding aspect of which has been so often described, rises

like a huge castle from the ocean. A great wall, built of successive streams of black lava, forms around the whole circuit a bold coast. Near the town, as if in aid of the natural defence, small forts and guns are every where built up, and mingled with the rugged rocks. The town extends up a flat and very narrow valley; the houses look respectable, and they are interspersed with a very few green trees. When approaching the anchorage there is one striking view: an irregular castle perched on the summit of a lofty hill, and surrounded by a few scattered fir-trees, boldly projects against the sky.

The next day I obtained lodgings within a stone's throw of Napoleon's tomb.* I confess, however, this had little attraction for me: but it was a capital central situation, whence I could make excursions in every direction. During the four days I staid here, from morning to night I wandered over the island, and examined its geological history. The house was situated at an elevation of about 2000 feet; here the weather was cold and very boisterous, with constant showers of rain; and every now and then the whole scene was veiled in thick clouds.

Near the coast the rough lava is entirely destitute of vegetation: in the central and higher parts, a different series of rocks have from extreme decomposition produced a clayey soil, which, where not covered by vegetation, is stained in broad bands of many bright colours. At this season the land, moistened by constant showers, produces a singularly bright green pasture; this lower and lower down, gradually fades away, and at last disappears. In latitude 16°, and at the trifling elevation of 1500 feet, it is surprising to behold a vegetation possessing a character decidedly English. The hills are crowned with irregular plantations of Scotch firs;

* After the volumes of eloquence which have poured forth on this subject, it is dangerous even to mention the tomb. A modern traveller in twelve lines, burdens the poor little island with the following titles,—it is a grave, tomb, pyramid, cemetery, sepulchre, catacomb, sarcophagus, minaret, and mausoleum!

and the sloping banks are thickly scattered over with thickets of gorze, covered with its bright yellow flowers. Weeping-willows are common along the course of the rivulets, and the hedges are made of the blackberry, producing its well-known fruit. When we consider that the number of plants now found on the island is 746, and that out of these, fifty-two alone are native species, the rest being imported, and many of them from England, we see a good reason for this English character in the vegetation. The numerous species which have been so recently introduced can hardly have failed to have destroyed some of the native kinds. I believe there is no accurate account of the state of the vegetation at the period when the island was covered with trees; such would have formed a most curious comparison with its present sterile condition, and limited Flora. Many English plants appear to flourish here better than in their native country; some also from the opposite quarter of Australia succeed remarkably well. It is only on the highest and steepest ridges, where the native Flora is still predominant.

The English, or rather the Welsh character of the scenery, is preserved by the numerous cottages and small white houses; some buried at the bottom of the deepest valleys, and others stuck up on the crests of the lofty hills. Some of the views are very striking; I may instance that from near Sir W. Doveton's house, where the bold peak called Lott is seen over a dark wood of firs, the whole being backed by the red water-worn mountains of the Southern shore.

On viewing the island from an eminence, the first circumstance which strikes one, is the very great number of roads, and forts: the labour bestowed on the public works, if one forgets its character as a prison, seem out of all proportion to its extent or value. There is so little level or useful land, that it seems surprising how so many people (about 5000) can subsist here. The lower orders, or the emancipated slaves, are I believe extremely poor: they complain of want of work, a fact which is likewise shown by the very cheap

labour. From the reduction in the number of public servants owing to the island having been given up by the East India Company, and the consequent emigration of many of the richer people, the poverty probably will increase. The chief food of the working class is rice with a little salt meat; as neither of these articles are the products of the island, but must be purchased with money, the low wages tell heavily on the poor people. The fine times, as my old guide called them, when "Bony" was here, can never return again. Now that the people are blessed with freedom, a right which I believe they value fully, it seems probable that their numbers will quickly increase: if so, what is to become of the little state of St. Helena?

My guide was an elderly man, who had been a goatherd when a boy, and knew every step amongst the rocks. He was of a race many times mixed, and although with a dusky skin, he had not the disagreeable expression of a mulatto. He was a very civil, quiet old man, and such appears the character of the greater number among the lower classes. It was strange to my ears to hear a man, nearly white, and respectably dressed, talking with indifference of the times when he was a slave. With my companion who carried our dinner and a horn of water, which latter is quite necessary as all in the lower valleys is saline, I every day took long walks.

Beneath the limits of the elevated and central green circle, the wild valleys are quite desolate and untenanted. Here, to the geologist, there are scenes of high interest, which show the successive changes, and complicated disturbances which have in past times happened. According to my views, St. Helena has existed as an island from a very remote epoch: some obscure proofs, however, of the elevation of the land are still extant. I believe that the central and highest peaks form parts of the rim of a great crater; the southern half of which has been removed by the waves of the sea. There is, moreover, an external margin of black volcanic rocks, which belong to an anterior condition of things. These have been dislocated and broken up by forces acting

from below, so that the confusion in structure from these different causes is extreme. On the higher parts of the island considerable numbers of shells occur embedded in the soil, which have always been supposed to be of marine origin: and the fact has been adduced as a proof of the retreat of the sea. The shell turns out to be a Bulimus, or terrestrial species. It is however very remarkable, that it is not now found in a living state: a circumstance which in all probability may be attributed to the entire destruction of the woods, and consequent loss of food and shelter, which occurred during the early part of the last century.

The history of the changes, which the elevated plains of Longwood and Deadwood have undergone, as given in General Beatson's account of the island, is extremely curious. It is said the plain in former times was covered with wood, and was therefore called the Great Wood. So late as the year 1716 there were many trees upon it, but in 1724 the old trees had mostly fallen; and as goats and hogs were at that time suffered to range about, all the young trees had been devoured. It appears also from the official records, that the trees were unexpectedly, some years afterwards, succeeded by indigenous wire grass, which now spreads over its whole extent.* He then adds, "These are curious facts, since they trace the changes which this remarkable spot of land has undergone, for now this formerly naked plain (after the trees had fallen) is covered with fine sward, and is become the finest piece of pasture on the island." The extent of surface, which was probably covered by wood at a former period is estimated at no less than two thousand acres; at the present day scarcely a tree can be found there. It is said, that in 1709 there were quantities of dead wood in Sandy Bay: this place is now so utterly desert, that nothing but so well-attested an account could make me believe that trees had ever existed there. The fact, that the goats and hogs destroyed all the young trees as they sprung up, and that in the course of time

* Beatson's St. Helena. Introductory chapter, p. iv.

the old ones, which were safe from their attacks, perished from age, seems clearly made out. Goats were introduced in the year 1502; eighty-six years afterwards, in the time of Cavendish, it is known they were exceedingly numerous. More than a century afterwards, in 1731, when the evil was completed and found irretrievable, an order was issued that all stray animals should be destroyed.

When at Valparaiso, I heard it positively affirmed, that the Sandal-wood tree had been found on the island of Juan Fernandez in considerable numbers, but that all without exception were standing dead. At the time, I thought it was some mysterious case of the natural death of a species; but when it is remembered, that goats for very many years have abounded on that island, it seems most probable that the young trees were prevented growing, and that the old ones perished from age. It is a very interesting fact, to observe that the arrival of animals at St. Helena in 1501 did not change the whole aspect of the island, until a period of two hundred and twenty years had elapsed: for they were introduced in 1502, and in 1724 it is said "the old trees had mostly fallen." There can be no doubt, this change affected not only the Bulimus and probably some other land shells (of which I obtained specimens from the same bed), but likewise a multitude of insects.

St. Helena, situated so remote from any continent, in the midst of a great ocean, and possessing a unique Flora,—this little world within itself,—excites our curiosity. Birds and insects,* as might have been expected, are very few in number;

* Among these few insects, I was surprised to find a small Aphodius (*nov. spec.*) and an Oryctes, both extremely common under dung. When the island was discovered it certainly possessed no quadruped, excepting *perhaps* a mouse; it becomes, therefore, a difficult point to ascertain, whether these stercovorous insects have since been imported by accident, or if aborigines, on what food they formerly subsisted. On the banks of the Plata, where, from the vast number of cattle and horses, the fine plains of turf are richly manured, it is vain to seek the many kinds of dung-feeding beetles, which occur so abundantly in Europe. I observed only an Oryctes (the insects of this genus in Europe generally feed

indeed I believe all the birds have been introduced within late years. Partridges and pheasants are tolerably abundant: the island is much too English, not to be subject to strict game-laws. I was told of a more unjust sacrifice to such ordinances, than I ever heard of even in England. The poor people formerly used to burn a plant, which grows on the coast rocks, and export soda; but a peremptory order came out prohibiting this practice, and giving as a reason, that the partridges would have nowhere to build!

In my walks, I passed more than once over the grassy plain, bounded by deep valleys, on which Longwood stands. Viewed from a short distance, it appears like a respectable gentleman's country-seat. In front there are a few cultivated fields, and beyond them, the hill of coloured rocks called the Flagstaff,

on decayed vegetable matter) and two species of Phanæus, common in such situations. On the opposite side of the Cordillera in Chiloe, another species of this genus is exceedingly abundant, and it buries the dung of cattle in large earthen balls beneath the ground. There is reason to believe that the genus Phanæus, before the introduction of cattle acted as scavengers to man. In Great Britain those beetles, which find support in the matter, which has already contributed towards the life of other and larger animals, are so numerous, that I suppose there are at least one hundred different kinds. Considering this, and observing what a quantity of food is thus lost on the plains of La Plata, I imagined I saw an instance where man had disturbed that chain, by which so many animals are linked together in their native country. To this view, however, Van Diemen's Land offers an exception (in the same manner as St. Helena does in a much lesser degree), for I found there four species of Onthophagus, two of Aphodius, and one of a third genus, very abundant under the dung of cows; yet these latter animals had then been introduced only thirty-three years. Previously to that time, the Kangaroo and some other small animals were the only quadrupeds; and their dung is of a very different quality from that of their successors introduced by man. In England the greater number of stercovorous beetles are confined in their appetites; that is, they do not depend indifferently on any quadruped for the means of subsistence. The change, therefore, in habits, which must have taken place in Van Diemen's Land, is the more remarkable.—I am indebted to the Rev. F. W. Hope, who, I hope, will permit me to call him my master in Entomology, for information respecting the foregoing, and other insects.

and the square black mass of the Barn. On the whole the view is rather bleak and uninteresting.

The scrupulous degree to which the coast must formerly have been guarded, is quite extraordinary: there are alarm houses, alarm guns, and alarm stations on every peak. I was much struck with the number of forts and picket houses, on the line leading down to Prosperous Bay. One would have supposed that this at least was an easy descent: I found it however a mere goat-path, and in one spot the use of ropes, which were fixed into rings in the cliff, were almost indispensable. At the present day two artillery-men are kept there; for what use it is not easy to conjecture. Prosperous Bay, although with so flourishing a name, has nothing more attractive than a wild sea-beach, and black utterly barren rocks. The only inconvenience I suffered in my walks, was from the impetuous winds. One day I noticed a curious circumstance: standing on the edge of a plain, terminated by a great cliff of about a thousand feet in depth, I saw at the distance of a few yards right to windward, some tern, struggling against a very strong breeze, whilst, where I stood, the air was quite calm. Approaching close to the brink, I stretched out my arm, which immediately felt the full force of the wind: an invisible barrier of two yards wide, separated a strongly agitated from a perfectly calm air. The current meeting the bold face of the cliff, must have been reflected upwards at a certain angle, within which plane there necessarily would be either an eddy or a calm.

I so much enjoyed my rambles among the rocks and mountains of St. Helena, that I felt almost sorry on the morning of the 14th to descend to the town. Before noon I was on board, and the Beagle made sail for Ascension.

We reached the anchorage of the latter place on the evening of the 19th (July). Those who have beheld a volcanic island, situated within an arid climate, will be able at once to picture to themselves the aspect of Ascension. They will imagine smooth conical hills of a bright red colour, with

their summits generally truncated, rising distinct out of a level surface of black rugged lava. A principal mound in the centre of the island, seems the father of the lesser cones. It is called Green Hill; its name is taken from the faintest tinge of that colour, which at this time of the year was barely perceptible from the anchorage. To complete this desolate scene, the black rocks on the coast are lashed by a wild and turbulent sea.

The settlement is near the beach; it consists of several houses and barracks placed irregularly, but well built of white freestone. The only inhabitants are marines, and some negroes liberated from slave-ships, who are paid and victualled by government. There is not a private person on the island. Many of the marines appeared well contented with their situation; they think it better to serve their one-and-twenty years on shore, let it be what it may, than in a ship: in which choice, if I were a marine, I would most heartily agree.

The next morning I ascended Green Hill, 2840 feet high, and thence walked across the island to the windward point. A good cart-road leads from the coast settlement to the houses, gardens, and fields, placed near the summit of the central mountain. On the roadside there are milestones, and likewise cisterns, where each thirsty passer-by, can drink some good water. Similar care is displayed in each part of the establishment, and especially in the management of the springs, so that a single drop of water shall not be lost: indeed the whole island may be compared to a huge ship kept in first-rate order. I could not help, when admiring the active industry which had created such effects out of such means, at the same time regretting that it was wasted on so poor and trifling an end. M. Lesson has remarked with justice, that the English nation alone would have thought of making the island of Ascension a productive spot; any other people would have held it without any further views, as a mere fortress in the ocean.

Near the coast nothing grows; a little inland an occa-

sional green castor-oil plant, and a few grasshoppers (true friends of the desert), may be met with. Some grass is scattered over the surface of the central elevated region, and the whole much resembles the worse parts of the Welsh mountains. But scanty as the pasture appears, about six hundred sheep, many goats, a few cows and horses, all thrive well on it. Of native animals, rats and land-crabs swarm in numbers: of native birds, there are none; but the guinea-fowl, imported from the Cape de Verd Islands, is abundant, and the common fowl has likewise run wild. Some cats, which were originally turned out to destroy the rats and mice, have increased so as to become a great plague. The island is entirely destitute of trees, in which, and in every other respect, it is very far inferior to St. Helena. Mr. Dring tells me, that the witty people of the latter place say, "we know we live on a rock, but the poor people of Ascension live on a cinder:" the distinction in truth is very just.

On the succeeding days, I took long walks and examined some rather curious points in the mineralogical composition of some of the volcanic rocks, to which I was guided by the kindness of Lieut. Evans. On the basaltic masses, which are daily washed by the tide, most curious calcareous incrustations have been deposited. They resemble in form certain cryptogamic plants, especially the Marchantiæ; their surface is perfectly smooth and glossy, and their colour black, which seems owing to animal matter. I have shown these incrustations to several geologists, and not one guessed their true origin. Any one would suppose that they had been the product of fire, rather than of a deposition of calcareous matter, now constantly undergoing a round of decay and renovation from the action of the breakers. Near the settlement where these incrustations occur, there is a large beach of calcareous sand, entirely composed of comminuted and rounded fragments of shells and corals. The lower part of this, from the percolation of water containing calcareous matter in solution, soon becomes consolidated, and is used

as a building stone; but some of the layers are too hard for freestone, and when struck by the hammer ring like flint.

The main line of beach is directed N.E. and S.W.; Lieutenant Evans informs me, that during the six months included between the 1st of April and the 1st of October, the sand accumulates towards the N.E. extremity, and during the other six it travels back again towards the S.W. end. This periodical movement is due to a change in the direction of the swell, which is influenced by the general direction of the trade-wind, during the two periods of the year. Lieutenant Evans also informs me that during the six years he has resided on this island, he has always observed, that in the months of October and November, when the sand commences travelling towards the S.W., the rocks which are situated at that end of the long beach, become coated by a white, thick, and very hard calcareous layer. I saw portions of this remarkable deposit, which had been protected by an accumulation of sand. In the year 1831 it was much thicker than during any other period. It would appear that the water, charged with calcareous matter by the disturbance of a vast mass of calcareous particles, only partially cemented together, deposits this substance on the first rocks against which it impinges. But the most singular circumstance is, that in the course of a couple of months this layer is either abraded or redissolved, so that after that period, it entirely disappears. It is curious thus to trace the origin of a periodical incrustation on certain isolated rocks, to the motion of the earth with relation to the sun; for this determines the atmospheric currents, which give the direction to the swell of the ocean, and this acts on the arrangement of the sea-beach, and this again on the quantity of calcareous matter held in solution by the waters of the neighbouring sea.

One of my excursions took me towards the S.W. extremity of the island. The day was clear and hot, and I saw the island, not smiling with beauty, but staring with naked

hideousness. The lava streams are covered with hummocks, and are rugged to a degree, which, geologically speaking, is not of easy explanation. The intervening spaces are concealed with layers of pumice, ashes, and volcanic tuft. In some parts rounded volcanic bombs, which must have assumed this form, when projected red-hot from the crater, lie strewed on the surface. Whilst passing at sea this end of the island, I could not imagine what was the nature of the white patches, with which the whole plain was mottled; I now found they were seafowl, which were sleeping in such full confidence, that even in midday a man could walk up to, and seize hold of them. These birds were the only living creatures I saw during the day. On the beach a great surf, although the breeze was light, was tumbling over the broken lava rocks.

Upon leaving Ascension the ship's head was directed towards the coast of South America, and on August 1st, we anchored at Bahia or San Salvador. We staid here four days, in which time I took several long walks. I was glad to find my enjoyment of tropical scenery had not decreased even in the slightest degree, from the want of novelty. The elements of the scenery are so simple, that they are worth mentioning, as a proof on what trifling circumstances exquisite natural beauty depends.

The country may be described as a level plain of about three hundred feet in elevation, which in every part has been worn into flat-bottomed valleys. This structure is remarkable in a granitic land, but is nearly universal in all those softer formations, of which plains usually are composed. The whole surface is covered by various kinds of stately trees, interspersed with patches of cultivated ground, out of which houses, convents, and chapels arise. It must be remembered that within the tropics, the wild luxuriance of nature is not lost even in the vicinity of large cities; for the natural vegetation of the hedges and hill-sides, overpowers in picturesque effect the artificial labour of man. Hence, there

are only a few spots where the bright red soil affords a strong contrast with the universal clothing of green. From the edges of the plain there are distant glimpses either of the ocean, or of the great bay bordered by low wooded shores, and on the surface of which numerous boats and canoes show their white sails. Excepting from these points, the range of vision is very limited: following the level pathways, on each hand alternate peeps into the wooded valleys below can alone be obtained. Finally, I may add that the houses, and especially the sacred edifices, are built in a peculiar and rather fantastic style of architecture. They are all whitewashed; so that when illuminated by the brilliant sun of midday, and as seen against the pale blue sky of the horizon, they stand out more like shadows than substantial buildings.

Such are the elements of the scenery, but to paint the effect is a hopeless endeavour. Learned naturalists describe these scenes of the tropics by naming a multitude of objects, and mentioning some characteristic feature of each. To a learned traveller, this possibly may communicate some definite ideas: but who else from seeing a plant in an herbarium can imagine its appearance when growing in its native soil? Who from seeing choice plants in a hothouse can magnify some into the dimensions of forest trees, and crowd others into an entangled jungle? Who when examining in the cabinet of the entomologist the gay exotic butterflies, and singular cicadas, will associate with these objects, the ceaseless harsh music of the latter, and the lazy flight of the former,—the sure accompaniments of the still, glowing, noonday of the tropics. It is, when the sun has attained its greatest height, that such views should be beheld: then the dense splendid foliage of the mango hides the ground with its darkest shade, whilst the upper branches are rendered from the profusion of light of the most brilliant green. In the temperate zones, as it appears to me, the case is different, the vegetation there is not so dark

or so rich, and hence the rays of the declining sun, tinged of a red, purple, or yellow colour, add most to the beauties of the scenery of those climes.

When quietly walking along the shady pathways, and admiring each successive view, one wishes to find language to express one's ideas. Epithet after epithet is found too weak to convey to those, who have not visited the intertropical regions, the sensation of delight which the mind experiences. I have said the plants in a hothouse fail to communicate a just idea of the vegetation, yet I must recur to it. The land is one great wild, untidy, luxuriant hothouse, which nature made for her managerie, but man has taken possession of it, and has studded it with gay houses and formal gardens. How great would be the desire in every admirer of nature to behold, if such were possible, another planet; yet to every one in Europe, it may be truly said, that at the distance of a few degrees from his native soil, the glories of another world are open to him. In my last walk, I stopped again and again to gaze on these beauties, and endeavoured to fix for ever in my mind an impression, which at the time I knew, sooner or later must fail. The form of the orange-tree, the cocoa-nut, the palm, the mango, the tree-fern, the banana, will remain clear and separate; but the thousand beauties which unite these into one perfect scene must fade away; yet they will leave, like a tale heard in childhood, a picture full of indistinct, but most beautiful figures.

August 6th.—In the afternoon we stood out to sea, with the intention of making a direct course to the Cape de Verd Islands. Unfavourable winds, however, having delayed us, on the 12th we ran into Pernambuco,—a large city on the coast of Brazil in latitude 8° south. We anchored outside the reef; but in a short time a pilot came on board, and took us into the inner harbour, where we lay close to the town.

Pernambuco is built on some narrow and low sandbanks, which are separated from each other by shoal channels of salt water. The three parts of the town are connected together

by two long bridges built on wooden piles. The town is in all parts disgusting, the streets being narrow, ill-paved, and filthy; the houses are very tall and gloomy. The number of white people, which during the morning may be met with in the streets, bears about the proportion of foreigners in any other nation; all the rest are black or of a dusky colour. The latter, as well as the Brazilians, are far from prepossessing in their appearance. The poor negroes, wherever they may be, are cheerful, talkative, and boisterous. There was nothing in the sight, smell, or sounds within this large town, which conveyed to my mind any pleasing impressions.

The season of heavy rains had hardly come to an end, and hence the surrounding country, which is scarcely elevated above the level of the sea, was flooded with water. I failed in all my attempts to take any long walks. I was, however, enabled to observe that many of the country-houses in the outskirts, had like those of Bahia a gay appearance, which harmonized well with the luxuriant character of the vegetation.

The flat swampy land on which Pernambuco stands, is surrounded at the distance of a few miles, by a semicircle of low hills, or rather by the edge of a country elevated perhaps two hundred feet above the sea. The old city of Olinda stands on one extremity of this range. One day I took a canoe, and proceeded up one of the channels to visit it; I found the old town from its situation both sweeter and cleaner than that of Pernambuco. I must here commemorate what happened for the first time during the four-and-a-half years we have been wandering about, namely, having met with a want of politeness amongst any class of people: I was refused in a sullen manner at two different houses, and obtained with difficulty from a third, permission to pass through their gardens, to an uncultivated hill, for the purpose of taking a view of the country. I feel quite glad that this happened in the land of the "Brava Gente," for I bear them no good will—a land also of slavery, and therefore of moral debasement. A Spaniard would have been ashamed

at the thought of refusing such a request, or of behaving to a stranger with rudeness. The channel by which we went to, and returned from Olinda, was bordered on each side by mangroves, which sprang like a miniature forest out of the greasy mud-banks. The bright green colour of these bushes always reminded me of the rank grass in a churchyard: both are nourished by putrid exhalations; the one speaks of death past, and the other too often of death to come.

The most curious thing which I saw in this neighbourhood, was the reef that forms the harbour. It runs for a length of several miles in a perfectly straight line, parallel to, and not far distant from, the shore. It varies in width from thirty to sixty yards; it is dry at low water, has a level smooth surface, and is composed of obscurely-stratified hard sandstone. Hence, at first sight, it is difficult to credit that it is the work of nature, and not of art. Its utility is great; close within the inner wall there is a good depth of water, and ships lie moored to old guns, which are fixed in holes on its summit. A lighthouse stands on one extremity, and around it the sea breaks heavily. In entering the harbour, a ship passes within thirty yards of this point, and amidst the foam of the breakers; close by, on the other hand, are other breakers, which thus form a narrow gateway. It is almost fearful to behold a ship running, as it appears, headlong into such dangers.

With respect to the origin of the reef, I believe a bar composed of sand and pebbles formerly existed beneath the water (a circumstance no ways improbable) when the low land, on which the town now stands, was occupied by a large bay; and that this bar was first consolidated, and then elevated. These two processes are of such frequent occurrence in South America, that there can be no objection to using them in accounting for any remarkable structure in the land. There is another and slightly different explanation which possesses equal probability, namely, that a long spit of sand, like some that now run parallel to parts of the neighbouring coast, had its central part consolidated, and

then by a slight change in the set of currents, the loose matter removed, so that the hard nucleus alone was left. Although the swell of the open ocean breaks heavily on the outside of this narrow and insignificant line of reef, yet there is no record of its decay. This durability is much the most curious circumstance in its history. Its protection appears due to a layer of calcareous matter, formed by the successive growth of several kinds of organic bodies, chiefly serpulæ, balani, nulliporæ, but no true corals. It is a process strictly analogous to the formation of peat; and like that substance, its effects are to preserve from degradation the matter on which it rests. In true coral reefs, when the upper extremities of the living mass are killed by the rays of the sun, they become enveloped and protected by a nearly similar process. It is probable, that if a breakwater, such as that at Plymouth, was built in these tropical seas, it would be imperishable; that is, as imperishable as any part of the solid land, all of which must some day suffer decay and renovation.

On the 17th we took our final leave of the coast of South America, and on the last day of the month anchored at Porto Praya. We staid there only five days, and on the 5th of September steered for the Azores. On the 19th we anchored off the town of Angra, the capital of Terceira.

This island is moderately lofty, and has a rounded outline, with detached conical hills evidently of volcanic origin. The land is well cultivated, and is divided into a multitude of rectangular fields by stone walls, extending from the water's edge to high up on the central hills. There are few or no trees, and the yellow stubble land at this time of the year gave a burnt-up and unpleasant character to the scenery. Small hamlets and single whitewashed houses are scattered in all parts. In the evening a party went on shore: we found the city a very clean and tidy little place, containing about 10,000 inhabitants, which includes nearly the fourth part of the total number on the island. There are no good shops, and there is little appearance of activity, excepting

the intolerable creaking of an occasional bullock-waggon. The churches are very respectable, and there were formerly a good many convents; but Dom Pedro destroyed several. He levelled three nunneries to the ground, and gave permission to the nuns to marry, which, except by some very old ones, was gladly received.

Angra was formerly the capital of the whole Archipelago, but it has now only one division of the islands under its government, and its glory has departed. The city is defended by a strong castle on Mount Brazil, and by a line of batteries encircling the base of this extinct volcano, which overlooks the town. Terceira was the first place that received Dom Pedro, and from this beginning he conquered the other islands, and finally Portugal. A loan was scraped together in this one island of no less than 400,000 dollars, of which sum not one farthing has ever been paid to these first supporters of the present right royal and honourable family.

The next day the Consul kindly lent me his horse, and furnished me with guides to proceed to a spot in the centre of the island, which was described as an active crater. Ascending in deep lanes, bordered on each side by high stone walls, for the three first miles we passed many houses and gardens. We then entered on a very irregular country, consisting of more recent streams of hummocky basaltic lava. The rocks are covered in some parts by a thick brushwood about three feet high, and in others by heath, fern, and short pasture: a few broken down old stone walls completed the resemblance with the mountains of Wales. I saw, moreover, some old English friends amongst the insects; and of birds, the starling, water-wagtail, chaffinch, and blackbird. There are no houses in this elevated and central part, and the ground is only used for the pasture of cattle and goats. On every side besides the ridges of more ancient lavas, there were cones of various dimensions, which still partly retained their crater-formed summits; and where broken down, showed a pile of cinders, such as those from an iron-foundry.

When we reached the so-called crater, I found it consisted of a slight depression, or rather of a short valley abutting against a higher range and without any exit. The bottom was traversed by several large fissures, out of which, in nearly a dozen places, small jets of steam issued as from the cracks in the boiler of a steam engine. The steam close to the irregular orifices was far too hot for the hand to endure it. It had but little smell, yet from every thing made of iron being blackened, and from a peculiar rough sensation communicated to the skin, the vapour cannot be pure; I imagine it contains some muriatic acid. The effect on the surrounding trachytic lava was singular, the solid stone being entirely converted either into pure snow-white porcelain clay, or into a kind of the brightest red, or the two colours were marbled together. The steam has thus been emitted during many years; and it is said that flames once issued from the cracks. During rain, the water from each bank must flow into these cracks; and it is probable that this same water trickling down to the neighbourhood of some heated subterranean lava, causes the above effects. Throughout the island, the powers from below have been unusually active during the last year; several small earthquakes have been felt, and during a few days a jet of steam issued from a bold precipice (part of Mount Brazil) overhanging the sea, not far from the town of Angra.

I enjoyed my day's ride, though I did not find much worth seeing. It was pleasant to meet the peasantry; I do not recollect ever having beheld a set of handsomer young men, with more goodhumoured expressions. The greater number whom we met, were employed in the mountains gathering sticks for firewood. A whole family, from the father to the least boy, might be seen, each carrying his bundle on his head to sell in the town. Their burdens were very heavy; this hard labour and the ragged state of their clothes plainly bespoke poverty; yet I am told it is not that they want food, but there is an absence of all luxuries,—a case parallel to that of Chiloe. Hence, although the whole land

is not cultivated, numbers are emigrating to Brazil, where the contract to which they are bound differs but little from slavery. It seems a great pity that so fine a population should be compelled to leave a land of plenty, where every article of food—meat, vegetables, and fruit—is exceedingly cheap and most abundant: but the labourer finds his labour of proportionally little value.

Another day I set out early in the morning to visit the town of Praya situated towards the N.E. extremity of the island. The distance is about fifteen miles; the road ran during the greater part of the way, not far from the coast. The country is all cultivated, and scattered over with houses and small villages. I noticed in several places, that the solid lava, which in part formed the road, was worn into ruts of the depth of twelve inches from the long traffic of the bullock-waggons. This circumstance has been noticed with surprise in the ancient pavement of Pompeii, for it does not occur in any of the present towns of Italy. The waggon-wheels here have a tire surmounted by singularly large knobs of iron; perhaps the old Roman wheels were thus furnished. The country during our morning's ride was not interesting; excepting always when enlivened by the pleasant sight of the healthy peasantry. The harvest was lately over, and near the houses, the fine yellow heads of the Indian corn were tied in large bundles, to be dried, to the poplar-trees; and these, seen from a distance, appeared weighed down by some beautiful fruit,—the very emblem of fertility.

One part of the road crossed a broad stream of lava, which from its rocky and black surface seemed to be of comparatively recent origin: indeed, the crater, whence it had flowed, could be distinguished. The industrious inhabitants have turned this space into vineyards; but for this purpose it was necessary to clear away the loose fragments, and to pile them up into a multitude of walls, which enclose little patches of ground a few yards square, thus covering the country with a network of black lines.

The town of Praya is a quiet, forlorn, little place: many

years since a large city was here overwhelmed by an earthquake. It is asserted that the land then subsided, and a wall of a convent now bathed by the sea, is shown as a proof of it: the fact is probable, but the supposed proof not conclusive. I returned home by another road, which first led along the northern shore, and then crossed the central part of the island. This north-eastern extremity is particularly well cultivated, and produces a large quantity of fine wheat. The square open fields, and small villages with whitewashed churches, gave to the view, as seen from the heights, an aspect resembling the less picturesque parts of central England. We soon reached the region of clouds, which during our whole visit hung very low and concealed the tops of the mountains. For a couple of hours we crossed this central and elevated part, which is not inhabited and has a desolate appearance. When we descended from the clouds to the city, I heard the good news that astronomical observations had been obtained, and that we should go to sea the same evening.

On the 25th we called at the island of St. Michael's for letters, and then steered a direct course for England. On October 2d the Beagle anchored at Falmouth, where I left her, having lived on board the little vessel very nearly five years.

As this volume may possibly fall into the hands of some one about to undertake a similar expedition, I will offer a few pieces of advice, some of which I observed with much advantage, but others, to my cost, neglected. Let the collector's motto be, "Trust nothing to the memory;" for the memory becomes a fickle guardian when one interesting object is succeeded by another still more interesting. Keep a list with the date of the ships by which *every* box of specimens, or even a letter, is transmitted to England; let the receiver do the same: it will afterwards save much anxiety. Put a number on every specimen, and every fragment of a specimen; and during the very same minute let it be

entered in the catalogue, so that if hereafter its locality be doubted, the collector may say in good truth, "Every specimen of mine was ticketed on the spot." Any thing which is folded up in paper, or put into a separate box, ought to have a number on the outside (with the exception perhaps of geological specimens), but more *especially* a duplicate number on the inside attached to the specimen itself. A series of small numbers should be printed from 0 to 5000; a stop must be added to those numbers which can be read upside down (as 699. or 86.). It is likewise convenient to have the different thousands printed on differently coloured paper, so that when unpacking, a single glance tells the approximate number.

For specimens in spirits of wine, I found the following plan answered admirably: Get a set of steel dies from 0 to 9, a small punch, and some sheets of *trebly*-thick tinfoil. The numbers may at any time be stamped in a line, with a hole punched in front of each, and then cut off with a pair of scissors as wanted. These tickets cost little trouble in making, and *do not corrode.* Each specimen in spirits should be loosely folded up in *very open* gauze, or some such stuff; the string which ties up the corners may likewise secure the number. Use nothing but glass jars; but these are difficult to be obtained of any size out of Europe. Jars of earthenware, and wooden casks, either leak, or allow of evaporation; and when such are used, it is not easy to know whether the specimens are too much crowded (a very common fault), or in what state the spirit is in, which through glass can be judged of by its colour. Bear in mind, that in nine out of ten specimens which are spoiled, it is owing to the spirit being too weak. The jars should be closed with a bung covered by bladder, twice by common tinfoil, and by bladder again; let the bladder soak till half putrid. I found this plan quite worth the trouble it cost.

Few, excepting those who have travelled in ships, know the extreme inconvenience of want of room; and on this much depends: but if it be practicable, keep three or four sets of

bottles open at the same time, so that one may serve for crustacea, another for animals for dissection, another for minute specimens, another for fish, always putting the latter into the strongest spirit. Any how it is absolutely necessary to keep a couple of receiving bottles in which every thing can at first be put, and afterwards transferred to the permanent bottles with *fresh spirits*. Without assistance from government, and plenty of room, it is most disheartening work to attempt to bring home many specimens in spirits, although without doubt in such a state they are very far the most valuable. I should recommend any one circumstanced as I was to preserve the skins only of large fish and reptiles. But with room and means at command, let the collector place no limit to the number of his glass jars.

With respect to the catalogues it is inconvenient to have many; but there must at least be two, one for the tin labels or specimens in spirits, and another for the paper numbers, which should be applied indiscriminately to every kind of specimen. If the observer has any particular branch to which he devotes much attention, a third catalogue exclusively for such specimens is desirable: I kept a third for geological specimens and fossils. In a like manner notes should be as simple as possible: I kept one set for geology, and another for zoological and all other observations. It is well to endeavour to write upon separate pages remarks on different specimens; for much copying will thus be saved. My journal was likewise kept distinct from the other subjects. I found an arrangement carried thus far very useful: a traveller by land would, I suppose, be obliged to adopt a still more simple plan.

Use arsenical soap* for all skins, but do not neglect to brush the legs and beak with a solution of corrosive sublimate.

* Seeds must not be sent home in the same case with skins prepared with poison, camphor, or essential oils; scarcely any of mine germinated, and Professor Henslow thinks they were thus killed.

Likewise slightly brush over all dried plants with the solution. For collecting insects use a plain strong sweeping-net, and pack the specimens of all orders, excepting lepidoptera, between layers of rag in pill-boxes, placing at the bottom a bit of camphor; this costs *scarcely any* trouble, and the insects, especially thousands of unknown minute ones, arrive in an excellent state. Take a good stock of chip pill-boxes—a simple plain strong microscope, such as that long ago described by Ellis—a good stock of lace-needles, with glass tubes and sealingwax, for the purpose of making dissecting instruments. I need not mention small collecting bottles covered with leather, tin boxes, dissecting scissors, blowpipe case, compasses, mountain barometer, &c. I should recommend a sort of work-box fitted up to hold watch-glasses, glass micrometers, pins, string, printed numbers, &c.; and I found a small cabinet with drawers, some lined with cork, and others with cross partitions, most useful as a temporary storehouse.

Pack up for shipment *every* specimen of *every* kind in boxes lined with tinned plates, and *soldered* together: if the case be large the specimens should further be packed into light pasteboard or other boxes, for by long pressure even skins of quadrupeds are injured. On no account whatever put bottles with spirits of wine, though ever so well packed, in the same case with other specimens, for if one should break every thing near it will be spoiled, as I found to my cost in one instance.

When limited either in time, funds, or space, let not the collector crowd too many specimens either into one bottle, or into one case. For he should *constantly* bear in mind as his second motto, that "It is better to send home a few things well preserved, than a multitude in a bad condition." As long as due steps are taken that the harvest may not be spoiled, let him not be disheartened, because he may for a long time be labouring by himself; let him work hard from morning to night, for every day and every hour is precious

in a foreign clime; and then most assuredly his own satisfaction will one day well repay him.

Our voyage having come to an end, I will take a short retrospect of the advantages and disadvantages, the pains and pleasures, of our five years' wandering. If a person should ask my advice, before undertaking a long voyage, my answer would depend upon his possessing a decided taste for some branch of knowledge, which could by such means be improved. No doubt it is a high satisfaction to behold various countries, and the many races of mankind, but the pleasures gained at the time do not counterbalance the evils. It is necessary to look forward to a harvest, however distant it may be, when some fruit will be reaped, some good effected.

Many of the losses which must be experienced are obvious; such as that of the society of all old friends, and of the sight of those places, with which every dearest remembrance is so intimately connected. These losses, however, are at the time partly relieved by the exhaustless delight of anticipating the long wished-for day of return. If, as poets say, life is a dream, I am sure in a voyage these are the visions which serve best to pass away the long night. Other losses, although not at first felt, tell heavily after a period; these are, the want of room, of seclusion, of rest;—the jading feeling of constant hurry;—the privation of small luxuries, the comforts of civilization and domestic society, and, lastly, even of music and the other pleasures of imagination. When such trifles are mentioned, it is evident that the real grievances (excepting from accidents) of a sea life are at an end. The short space of sixty years has made an astonishing difference in the facility of distant navigation. Even in the time of Cook, a man who left his comfortable fireside for such expeditions, underwent severe privations. A yacht now with every luxury of life might circumnavigate the globe. Besides the vast improvements in ships and naval resources, the whole western shores of America are thrown open, and

Australia has become the metropolis of a rising continent. How different are the circumstances to a man shipwrecked at the present day in the Pacific, to what they were in the time of Cook! since his voyage a hemisphere has been added to the civilized world.

If a person suffer much from sea-sickness, let him weigh it heavily in the balance. I speak from experience: it is no trifling evil which may be cured in a week. If, on the other hand, he takes pleasure in naval tactics, he will assuredly have full scope for his taste. But it must be borne in mind, how large a proportion of the time, during a long voyage, is spent on the water, as compared with the days in harbour. And what are the boasted glories of the illimitable ocean? A tedious waste, a desert of water, as the Arabian calls it. No doubt there are some delightful scenes. A moonlight night, with the clear heavens and the dark glittering sea, and the white sails filled by the soft air of a gently-blowing trade-wind;—a dead calm, with the heaving surface polished like a mirror, and all still, except the occasional flapping of the sails. It is well once to behold a squall with its rising arch and coming fury, or the heavy gale of wind and mountainous waves. I confess, however, my imagination had painted something more grand, more terrific in the full-grown storm. It is an incomparably finer spectacle when beheld on shore, where the waving trees, the wild flight of the birds, the dark shadows and bright lights, the rushing of the torrents, all proclaim the strife of the unloosed elements. At sea the albatross and petrel fly as if the storm were their proper sphere, the water rises and sinks as if fulfilling its usual task, the ship alone and its inhabitants seem the objects of wrath. On a forlorn and weather-beaten coast, the scene is indeed different, but the feelings partake more of horror than of wild delight.

Let us now look at the brighter side of the past time. The pleasure derived from beholding the scenery and the general aspect of the various countries we have visited, has

decidedly been the most constant and highest source of enjoyment. It is probable that the picturesque beauty of many parts of Europe exceeds any thing we have beheld. But there is a growing pleasure in comparing the character of scenery in different countries, which to a certain degree is distinct from merely admiring its beauty. It depends more on an acquaintance with the individual parts of each view. I am strongly induced to believe that, as in music, the person who understands every note will, if he also possesses a proper taste, more thoroughly enjoy the whole, so he who examines each part of a fine view, may also thoroughly comprehend the full and combined effect. Hence, a traveller should be a botanist, for in all views plants form the chief embellishment. Group masses of naked rock even in the wildest forms, and they may for a time afford a sublime spectacle, but they will soon grow monotonous. Paint them with bright and varied colours, they will become fantastic; clothe them with vegetation, they must form at least a decent, if not a most beautiful picture.

When I said that the scenery of Europe was probably superior to any thing which we have beheld, I excepted, as a class by itself, that of the intertropical regions. The two classes cannot be compared together; but I have already often enlarged on the grandeur of these climates. As the force of impressions generally depends on preconceived ideas, I may add, that all mine were taken from the vivid descriptions in the Personal Narrative of Humboldt, which far exceed in merit any thing I have read on the subject. Yet with these high-wrought ideas, my feelings were far from partaking of any tinge of disappointment on first landing on the shores of Brazil.

Among the scenes which are deeply impressed on my mind, none exceed in sublimity the primeval forests undefaced by the hand of man; whether those of Brazil, where the powers of Life are predominant, or those of Tierra del Fuego, where Death and Decay prevail. Both are temples

filled with the varied productions of the God of Nature:—no one can stand in these solitudes unmoved, and not feel that there is more in man than the mere breath of his body. In calling up images of the past, I find the plains of Patagonia frequently cross before my eyes: yet these plains are pronounced by all most wretched and useless. They are characterized only by negative possessions; without habitations, without water, without trees, without mountains, they support merely a few dwarf plants. Why then, and the case is not peculiar to myself, have these arid wastes taken so firm possession of the memory? Why have not the still more level, the greener and more fertile Pampas, which are serviceable to mankind, produced an equal impression? I can scarcely analyze these feelings: but it must be partly owing to the free scope given to the imagination. The plains of Patagonia are boundless, for they are scarcely practicable, and hence unknown: they bear the stamp of having thus lasted for ages, and there appears no limit to their duration through future time. If, as the ancients supposed, the flat earth was surrounded by an impassable breadth of water, or by deserts heated to an intolerable excess, who would not look at these last boundaries to man's knowledge with deep but ill-defined sensations?

Lastly, of natural scenery, the views from lofty mountains, though certainly in one sense not beautiful, are very memorable. When looking down from the crest of the highest Cordillera, the mind undisturbed by minute details, was filled with the stupendous dimensions of the surrounding masses.

Of individual objects, perhaps no one is more certain to create astonishment than the first sight in his native haunt of a real barbarian,—of man in his lowest and most savage state. One's mind hurries back over past centuries, and then asks, could our progenitors have been such as these? Men, whose very signs and expressions are less intelligible to us than those of the domesticated animals; men, who do not possess the instinct of those animals, nor yet appear to boast of

human reason, or at least of arts consequent on that reason. I do not believe it is possible to describe or paint the difference between savage and civilized man. It is the difference between a wild and tame animal: and part of the interest in beholding a savage, is the same which would lead every one to desire to see the lion in his desert, the tiger tearing his prey in the jungle, the rhinoceros on the wide plain, or the hippopotamus wallowing in the mud of some African river.

Among the other most remarkable spectacles which we have beheld, may be ranked the stars of the southern hemisphere—the water-spout—the glacier leading its blue stream of ice in a bold precipice overhanging the sea—a lagoon island raised by the coral-forming polypi—an active volcano—and the overwhelming effects of a violent earthquake. The three latter phenomena, perhaps, possess for me a peculiar interest, from their intimate connexion with the geological structure of the world. The earthquake must however, be to every one a most impressive event: the earth, considered from our earliest childhood as the type of solidity, has oscillated like a thin crust beneath our feet; and in seeing the most beautiful and laboured works of man in a moment overthrown, we feel the insignificance of his boasted power.

It has been said, that the love of the chase is an inherent delight in man—a relic of an instinctive passion. If so, I am sure the pleasure of living in the open air, with the sky for a roof, and the ground for a table, is part of the same feeling: it is the savage returning to his wild and native habits. I always look back to our boat cruises, and my land journeys, when through unfrequented countries, with a kind of extreme delight, which no scenes of civilization could have created. I do not doubt that every traveller must remember the glowing sense of happiness he experienced, from the simple consciousness of breathing in a foreign clime, where the civilized man has seldom or never trod.

There are several other sources of enjoyment in a long voyage, which are, perhaps, of a more reasonable nature.

The map of the world ceases to be a blank; it becomes a picture full of the most varied and animated figures. Each part assumes its true dimensions: continents are not looked at in the light of islands, or those islands considered as mere specks, which are, in truth, larger than many kingdoms of Europe. Africa, or North and South America, are well-sounding names, and easily pronounced; but it is not till having sailed for some weeks along small portions of their coasts that one is thoroughly convinced how large a portion of our immense world these names imply.

From seeing the present state, it is impossible not to look forward with high expectation to the future progress of nearly an entire hemisphere. The march of improvement, consequent on the introduction of Christianity throughout the South Sea, probably stands by itself on the records of history. It is the more striking when we remember that only sixty years since, Cook, whose most excellent judgment none will dispute, could foresee no prospect of such change. Yet these changes have now been effected by the philanthropic spirit of the British nation.

In the same quarter of the globe Australia is rising, or indeed may be said to have risen, into a grand centre of civilization, which at some not very remote period, will rule as empress over the southern hemisphere. It is impossible for an Englishman to behold these distant colonies, without a high pride and satisfaction. To hoist the British flag, seems to draw with it as a certain consequence, wealth, prosperity, and civilization.

In conclusion, it appears to me that nothing can be more improving to a young naturalist, than a journey in distant countries. It both sharpens, and partly likewise allays that want and craving, which, as Sir J. Herschel* remarks, a man experiences although every corporeal sense is fully satisfied. The excitement from the novelty of objects, and the chance of success, stimulate him to increased activity. Moreover as

* Discourse on the Study of Natural Philosophy.

a number of isolated facts soon become uninteresting, the habit of comparison leads to generalization. On the other hand, as the traveller stays but a short space of time in each place, his descriptions must generally consist of mere sketches, instead of detailed observation. Hence arises, as I have found to my cost, a constant tendency to fill up the wide gaps of knowledge, by inaccurate and superficial hypotheses.

But I have too deeply enjoyed the voyage, not to recommend any naturalist, although he must not expect to be so fortunate in his companions as I have been, to take all chances, and to start, on travels by land if possible, if otherwise on a long voyage. He may feel assured, he will meet with no difficulties or dangers (excepting in rare cases) nearly so bad as he beforehand anticipated. In a moral point of view, the effect ought to be, to teach him good-humoured patience, freedom from selfishness, the habit of acting for himself, and of making the best of every thing, or in other words contentment. In short he should partake of the characteristic qualities of the greater number of sailors. Travelling ought also to teach him distrust; but at the same time he will discover, how many truly goodnatured people there are, with whom he never before had, or ever again will have any further communication, who yet are ready to offer him the most disinterested assistance.

ADDENDA.

Page 76.

I HAVE said that crystals of sulphate of magnesia, called by the Spanish inhabitants, *madre del sal*, are scattered on the borders of the Salinas in Patagonia. By a mistake a wrong bottle was examined; and the crystals, I now find, are the sulphate of soda; but it appears that some sulphate of magnesia is dissolved in the underlying fetid mud.

Page 96.

In enumerating the fossils, which I collected at Bahia Blanca, I mention a tusk like that of a boar, and some very flat grinders. These are now found to belong to the lower jaw of *Toxodon Platensis*. For an admirable description of this wonderful animal, and likewise of the great fossil (*Macrauchenia Patachonica*), mentioned at p. 208, which in some respects is allied to the Camelidæ, I must refer to the first part of the Zoology of the Voyage of the Beagle by Mr. Owen.

Page 97.

The remains just referred to, are said to be embedded with existing species of shells. This expression requires some qualification; the details are given in my geological introduction to Mr. Owen's account of the Fossil Mammalia, above mentioned.

Page 150.

With reference to what I have said, about the bones of horses having been several times brought to this country from North America, with those of the Mastodon, I see Mr. Rogers, in his Report to the British Association (vol. iii., p. 24) says, "It is possible that the horse ought to

be added to this list of animals as indigenous to America;" and it is evident from a previous passage, that the bones have been found fossil. Mr. Rogers states, that the remains of two kinds of elephant and three kinds of oxen have been discovered there; as have, on two occasions, parts of the Megatherium. At Big Bone Lick, where the remains of the elephant, mastodon, and ox, are so extraordinarily numerous, the megalonyx has been found; and this is a parallel case to the contemporaneous embedment, in the southern hemisphere, of the mastodon, horse, megatherium, and the other Edentata. The more I reflect on the geographical distribution in the Old and New World of these gigantic mammifers, during the period antecedent to the present, in relation to the existing faunas of North and South America, now so strongly contrasted with each other, the more pregnant with interest the case appears to be. I know of no other instance, in which we can thus almost mark the period of the splitting up of one great region into two well characterized zoological provinces. With respect to the ancient range of the genus Equus, I may add to what has already been said, that its remains have been found from England in the west, to the Himalaya in the east, (*Buckland's Reliquiæ Diluvianæ*, p. 222,) and from the western coast of North America, to the eastern plains of America in the southern hemisphere. We may, therefore, suspect that a very little research would discover the remains of the horse, embedded in the frozen soil of Kamtschatka, with those of the fossil ox and elephant; and thus render complete the evidence, that we there see the ancient, but perhaps temporary line of junction, since interrupted, between the fauna of what we call the New World with that of the Old. But I doubt not, that the snow-clad heights of Chimborazo, Illimani and Aconcagua have seen as many, and as strange forms of animals, pass by and become extinct, as ever did the Alpine pinnacles, or those loftiest ones of the Himalaya.

Page 268.

When contrasting the productions of the eastern coast of South America, with those of the western, and likewise with those of the corresponding parallels of latitude in Europe, I should have added (line 15) after the grape and fig, as flourishing in lat. 41°, the peach, and the nectarine (both of course standards), water and musk melons, batatas dulces (*Convolvulus batatas*), the olive and the orange; the latter, however, had only been lately introduced, but it promised to succeed well.

Page 272.

I have spoken of the low latitudes in which tropical forms of vegetation

are found in the southern hemisphere, and likewise of some mammalia and of birds. With respect to the parrot of the Strait of Magellan, Macquarrie Island in lat. 55° S. and long. 160° E. offers an analogous instance, in possessing a species of this genus. I am, however, now enabled to bring forward a more important observation, as directly bearing on the evidence by which geologists have chiefly judged of the climate of ancient Europe, namely, on the character of the marine productions of the southern hemisphere. In my journal I have remarked that the southern seas teem with life, under innumerable forms; and the truth of this remark is amply attested by the vast herds of great unwieldy seals with which the shores of Patagonia, the Falkland and the Antarctic islands, were, according to the narratives of all the early navigators, almost covered. Having mentioned these facts to Mr. George B. Sowerby, he informs me, that the shells of the southern part of the southern hemisphere have some affinity in general character with those of the intertropical seas, or rather that they are of much larger size and of more vigorous growth than the analogous species (excepting the chitons of California) under corresponding zones in the northern hemisphere. Thus the immense size of the Patellæ, Fissurellæ, Chitons, and Barnacles of the Strait of Magellan, and the large size of the former at the Cape of Good Hope, may be taken as instances. On the east coast of South America (in lat. 39°) three species of Oliva (one of large size), a Voluta (and perhaps a second species), and a Terebra, are amongst the *most abundant* shells on the mud-banks of Bahia Blanca. Another species of Voluta is found as far south as 45°, and there is some reason to believe, even much further. Oliva, Voluta, and Terebra are amongst the best-characterized tropical forms, that is, both the individuals and species of these genera are extremely abundant in the intertropical seas, whilst they are very rare, or do not exist, on the shores of temperate countries. It is doubtful even if one small species of these three genera, an Oliva, inhabits the southern shores of Europe; whilst in a *higher* latitude, on the coast of South America, species of all three are the most *abundant* kinds.

At Bahia Blanca many of these shells are embedded in gravel, and have been raised above the level of the sea. Now let us suppose that the climate of South America and of the surrounding seas were to undergo some change, so as to become in every respect like that of Europe; it can, I think, scarcely be doubted, that the shells of the abovementioned genera would gradually become extinct, and be replaced by others better adapted to the new climate. What, then, would a geologist say, who entertained the generally-received opinions on the distribution of organic beings in accordance with our knowledge of the northern hemisphere (or, rather, in this imaginary case of both hemispheres), when he found these gravel beds abounding with Olivas, Volutas, and Terebras?—such

shells not existing there. We may also suppose that he had discovered that the limits of the more tropical forms, both animal and vegetable, of the productions of the land, had likewise during this former period extended further south: what, then, would he say? Would he not at once infer, with the strongest appearance of truth, that the climate formerly had a more tropical character, properly so called, and therefore had a higher annual mean temperature than at present? Nevertheless, we know such an inference would have been absolutely erroneous. To put the case in another point of view: should a geologist find, in lat. 39°, on the coast of Spain, a tertiary deposit, abounding with Olivas, Volutas, and Terebras; or in lat. 45°, on the coast of France, other beds, containing a large Voluta, and numerous Patellæ, Fissurellæ, Chitons, and Balani, larger and of stronger growth than the existing species, would he be justified, after what is now known, in pronouncing that the climate formerly had a higher mean temperature? I think it may be safely asserted that he would not be so justified, but rather would be bound to search for other evidence. In the actual case of Europe, we have knowledge (as will be shown in a following note*) of another element in the problem, namely of the lower descent during former times of the snow-line,—as is inferred from the former low descent of glaciers, on the same mountains, where they now occur only at great heights, and likewise from the congelation during this same period of the soil in a low latitude—and this new element, I believe, gives the key to the solution of the problem, which is, that the climate of Europe was formerly more equable, but so far from being strictly more tropical, that it probably even had a lower mean annual temperature than it now possesses. I need scarcely say that I here refer *only* to the later tertiary periods: in the more ancient epochs, the plainest analogies tell us of an equatorial climate, whilst on the other hand, we are very far from having the smallest reason to suppose that the snow-line then descended low; and this is the key, as Ihave called it, to the problem of later times.

Page 282.

With respect to ice transporting fragments of rock in the Antarctic regions, M. Cordier, in his instructions *(L'Institut*, 1837, p. 283*)* to the voyage of the Astrolabe and the Zélée, has this passage: " Les relations de l'expédition anglo-américaine de découverte exécutée en 1830, nous ont

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* As these notes are appended to the Journal, I have found it scarcely possible to classify them properly. I have been obliged to allude to the lower descent of the glaciers in Europe during former periods—facts which are first brought forward in a succeeding note to p. 294.

fait connaître que les plages des Nouvelles-Shetland sont couvertes de grands blocs erratiques formés de granite, et par conséquent d'une nature différente des autres roches du pays. M. James Eights, naturaliste de l'expédition, n'hésite pas à considérer ces blocs comme ayant été apportés par les glaces, qui viennent annuellement s'échouer et se fondre sur les plages dont il s'agit et comme étant les indices de terres inconnues situées plus près du pôle que la terre la Trinité." I have not been able to find any account of this expedition. Lieutenant Kendall describes (*Geograph. Journal*, 1830) pinnacles of syenite in Smith's Island, one of the South Shetland group; so that the inferences regarding the distances, from which the blocks are supposed to have come, probably are erroneous.

In speaking (p. 272) of the rigour of the climate of Deception Island in South Shetland, I might have mentioned that Lieut. Kendall says (*Geograph. Journal*, 1830, p. 66), that on March the 8th, "We took the hint of the freezing over of the cove (lat. 62° 55′) and effected our retreat." This is the same as if, in the northern hemisphere, the harbour of Christiansund in Norway, were to freeze on the 8th of September!

Page 285.

I have described the dimensions of the great glacier which in lat. 46° 50′, sends down an arm to Kelly Harbour, and another to a flat swamp; I now find from information communicated to me by Captain FitzRoy, that it must communicate with the channels and bays northward, which extend behind the peninsula of Tres Montes. Aguëros, in giving an account of an expedition of the missionaries (*Descripcion Historial de la Provincia de Chiloe*, p. 227), says, they encountered in the Laguna de San Rafael (lat. 46° 33′ to 46° 48′) "many icebergs (*muchos farallones de nieve*), some great, some small, and others middle sized." This was on the 22d of November, 1778. Captain FitzRoy also tells me, that in the account of another missionary voyage, it is said that the boats had difficulty, on account of the islands of ice, in passing through the Caño de Perdon, a strait connecting the Laguna de San Rafael, with the other bays behind Tres Montes. Transposing in imagination, as I have done at p. 291, the places in the southern hemisphere to corresponding ones in Europe, these facts are the same as if, in a channel of the sea stretching from the Mediterranean between the Alps and the Jura, a boat should encounter *in the latitude of the lake of Geneva*, and *on the 22d of June*, (but not on one occasion only,) so many icebergs, and of such dimensions, that the historian of the voyage should describe them as being "some great, some small, and others middle sized"!

Having insisted so strongly, in this part of my Journal, that it is in the southern hemisphere, where tropical forms encroach on the temperate

zones, that solid glaciers descend to the sea in low latitudes; I might have added that it is in this same hemisphere, that the icebergs, which have been formed in the Polar Regions, are drifted furthest from their birthplace. Horsburgh (*Philosoph. Transact.*, 1830) describes several great icebergs seen by a ship, in her passage to India, in 35° 50′ S.: that is, far to the northward of the latitude, where tree-ferns, arborescent grasses, parasitical orchideous plants, and even palm-trees grow; and within sixty miles of the land, where the rhinoceros, elephant, hippopotamus, lion, and hyena, are very numerous.

Page 289.

Until lately I was not aware that there were sufficient data to speak with some precision of the southern limits of erratic blocks in the northern half of the New World. In Canada, and in the northern parts of the United States, innumerable great scattered fragments of rocks have been described by Bayfield, Bigsly, Hitchcock, and others. In parts of Massachusetts, according to Professor Hitchcock (*Report on the Geology of*), boulders seem to cover the whole face of the country. Further southward we hear from Mr. Rogers (*Report to Brit. Assoc.*, vol. iii.) that boulders are common over the great valley which crosses Pennsylvania, Maryland, and Virginia (lat. 36° 30′ to 42°): and likewise in the states of Ohio, Kentucky, and Indiana, which are in nearly the same latitude. Mr. Rogers having described some blocks of sandstone at Washington and on the Susquehanna, which must have come from some distance northward, adds that "Drake in his picture of Cincinnati (39° 10′) mentions large masses of granite in that part of the Ohio, resting on the ordinary finer diluvium. The nearest granite to the north is at least one hundred leagues distant; while no primary rock occurs south or east, within even a much greater limit." He then proceeds, "We are reminded here of the great detached blocks, which strew the plains of northern Europe, and the explanation suggested, that they have been carried there upon floating ice;" and concludes with the important remark, that Mr. Conrad, who has explored the state of Alabama (30° to 35°) was never once able to perceive a boulder upon its surface. It would hence appear that 36° 30′ is the southern limit of the dispersion of erratic blocks in the United States; and these are spoken of, as having come from the north. Therefore, there is no occasion to suppose that the ice, in which by the theory they are believed to have been embedded, was formed in so low a latitude as that here mentioned; and at present, in the southern hemisphere, icebergs are *drifted* to latitudes, though not formed in them, nearer the tropic than 36° 30′. In Europe I cannot hear of erratic blocks having been found further south than the southern flanks of the Alps, in lat. 45°; and Hum-

boldt has said (see *Cuvier's Theory of the Earth, translated by Professor Jameson*, p. 346) that they do not occur in Lombardy. I may here remark, that care should be taken to separate the phenomenon of great *angular* blocks, from that of rounded ones, although of considerable size; for torrents, and more especially the waves of the sea, during its slow oscillation of level, are agents sufficiently powerful to produce great effects. The lowest latitude in South America, in which I found large angular fragments, which must have been transported by ice there formed, or by some unknown means, was in latitude 41°. But as I did not examine the country immediately north of it, I am not prepared to say that this is their extreme limit; but between latitude 27° and 33°, I found no appearance, on either side of the Cordillera, which indicated a power of transportation of the kind required to remove boulders from a distance. Thus, we find that the limit of their dispersion in the two Americas is nearly the same; although they approach the warmer zones rather more closely in the northern than in the southern division of the continent, and in both, probably, more so than in Europe.

In the note, in which I have considered the apparent exceptions to the law, that erratic boulders are not found in the intertropical regions, I have said that the internal evidence of the Macao case led me to doubt its reality, and I now find it is distinctly stated by M. Chevalier that the rounded blocks result from the secular disintegration of the fundamental rock (*L'Institut*, 1838, p. 151—*Analysis of the Voyage of the Bonite*). I may here add, that M. Puillon Boblaye, in his description of Bone and Constantine on the northern coast of Africa (*L'Institut*, 1838, p. 248, says, "Je n'ai rien vu que pût indiquer le phénomène des blocs erratiques." My statement that erratic boulders are not found in Australia, is fully borne out by information communicated to me by Major Mitchell, who, in his repeated expeditions, has traversed so much of the south-east division of that continent. With the several facts given here and in the Journal (p. 289), I can scarcely doubt that the law of the distribution of erratic blocks is finally determined; and it is needless to specify the great, not to say conclusive, importance of this law on the theory of the means of their transportation, — a problem which has so long perplexed geologists.

Page 294.

In my discussion on the climate of the southern hemisphere, I have shown that a low altitude of the line of perpetual snow, and consequently the descent of glaciers to the level of the sea in latitudes relatively low to what occurs in the northern hemisphere, and likewise the perpetual congelation of the soil a little beneath the surface in countries without the

frigid zone, are the results of a climate which appears favourable to the passage of tropical forms beyond their proper limits, and to a vigorous native vegetation. The climate is one of an equable nature; and this must, to a considerable degree, be the effect of the great area of ocean compared with the land of the southern hemisphere. In the northern hemisphere we have proofs, that the productions both of the land and water, during the period antecedent to the present, had a more tropical character than they now have, and there is, also, a high degree of probability that the proportional area of water was much greater.

If then we judge from the analogy of the southern hemisphere, the first and simple inference from these facts, is, that the temperature of Europe was formerly more equable, though perhaps with a lower mean, than it now is. It may be asked, as a test of this inference, did the snow-line formerly descend lower than it now does? Was the soil formerly frozen a little beneath the surface in a low latitude? The congealed carcasses of the great Pachydermata of Siberia answer the second question; and in my journal, I have indirectly considered the first one as answered, by the fact of the many erratic boulders of Europe having travelled from mountains, situated in regions where great bodies of ice do not at present descend to the level of the sea. For on the theory that these boulders were transported by icebergs from glaciers, which formerly descended into the sea in latitudes where perpetual snow is not now found, or if so, only at great heights, the problem receives so simple a solution, that I did not hesitate, having the other data, to assume, that the snow-line in Europe formerly did descend much lower than it does at present. But, had I studied my subject more attentively, I might have taken a higher ground: in a note, indeed (p. 294), I have stated that according to Professor Esmark, it is certain, that the glaciers of Norway formerly descended to a lower level; and I now found that some time since, Messrs. Venetz and Charpentier, and more lately M. Agassiz, have incontestably shown, from the presence of glacier-dikes or moraines, and from the polished and scratched surface of the rocks, that in the Alps enormous bodies of ice formerly descended to the borders even of the lake of Geneva, and therefore much lower than the line of present lowest descent.* With these several facts it might have been boldly asserted, that the climate of Europe formerly was like

* No doubt if much more snow fell formerly than at present, the glaciers would formerly have descended somewhat lower; but as Europe now has a moderately humid climate, it is improbable in the highest degree (if indeed possible) that a difference of that kind could have caused the former extremely low descent of the ancient glaciers of the Alps: therefore we are compelled to attribute the difference to a change of temperature of some kind.

that of the southern hemisphere as it now is; and consequently, as we know, that the sea within recent tertiary periods stood at a higher level over a large portion of our continent, it might have been affirmed, had there been no record of the existence of erratic blocks on this side of the globe, that it would be an anomaly, difficult of explanation, should there not be found around the eminences of central and northern Europe great unrolled fragments, scattered at long distances from their parent sources, and often separated from them by profound valleys.

M. Agassiz has lately (*Address to the Helvetic Society, July* 1837, *translated in Jameson's New Philosophical Journal*, vol. xxiii., p. 364, *and in several communications in the French periodical L'Institut*) written on the subject of the glaciers and boulders of the Alps. He clearly proves, as it appears to me, that the presence of the boulders on the Jura cannot be explained by any debacle, or by the power of ancient glaciers driving before them moraines, or by the subsequent elevation of the surface on which the boulders now lie. M. Agassiz also denies that they were transported by floating ice, but he does not fully state his objections to this theory; nor does he oppose it, by the argument of the apparent anomaly of a low descent of glaciers, with the generally-received opinion of the more tropical character of the productions of the antecedent periods,—which was philosophical, until the effects of a temperate and equable climate were considered.* On the contrary, he assumes that, during the gradual cooling of the earth, there have been periods of excessive refrigeration. It is needless to state that such an hypothesis is not supported by a single fact—without, indeed, the *assumed* sudden renewal of life on the surface of the world at successive periods be considered such. During this imagined period of excessive refrigeration, the Alps and the greater part of Europe, and even of Asia, are supposed to have been covered by one immense sheet of ice, and during the *assumed* sudden elevation of the Alps, fragments of rocks are supposed to have been shot over the frozen surface, and, when the ice melted, to have dropped on the surface where they now lie. M. Agassiz considers that this view explains the position of the boulders on pinnacles, and their absence in the valleys. I confess I should have thought, after the flexure and elevation of the ice, these would have been the least probable situations: but neither this, or some

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* M. Charpentier (*in his account of M. Venetz's investigations on the Glaciers of the Valais—Edinburgh New Philosophical Journal*, vol. xxi., p. 215) was fully aware of this difficulty. His explanation rests on a supposed enormous oscillation of level in the Alps,—an assumption which is unsupported by other facts, and is not applicable to the general case of Europe.

other facts (p. 381), are quite intelligible to me from the briefness, with which they are alluded to. M. Agassiz says (p. 375), "The erratic blocks of the Jura every where repose on polished surfaces, all those at least which have not been carried beyond the crest of our mountains, and which have not fallen to the bottom of our longitudinal valleys, as may be seen throughout the valleys of the Creux du Vent. But they do not repose immediately upon these polished surfaces. Wherever the rounded pebbles which accompany the great blocks have not been removed by subsequent influences, it is remarked that small blocks, in other words pebbles of different sizes, form a bed of some inches, and sometimes even of many feet, upon which the great angular blocks repose. These pebbles are also much rounded, even polished, and are heaped up in such a way that the larger are above the smaller, and that the last often pass below into a fine sand, lying immediately over the polished surfaces. This order of superposition, which is constant, is opposed to all idea of a transport by currents; for in this latter case the order of the superposition of the pebbles would have been precisely reversed." Further on (p. 379) he remarks that the action of the glaciers is immense; "for these masses, continually moving upon each other, and on the surface, bruise and grind down every thing moveable, and polish the solid surfaces on which they repose; at the same time that they push before them all that they encounter, with a force which is irresistible. It is to these movements (of the great stratum of ice) we must attribute the strange superposition of the rolled pebbles, and of the sand, which immediately reposes upon the polished surfaces; and it is unquestionably to the grating of this sand upon these surfaces that the fine lines which we find (previously compared to the scratches made by a diamond on glass) are owing, and which would never have existed, if the sand had been acted upon by a current of water." Now it may be demanded, by what possible means can such violent action arrange the large pebbles above the smaller ones, and these again above the sand? The fact appears to me utterly inexplicable on this view. Again it is said, that the surface of the rock is marked by furrows and gibbosities, as well as by scratches, and that these "never follow the direction of the slope of the mountain, but are oblique and longitudinal (that is, in the line of the mountain, and therefore nearly horizontal), a direction which excludes every idea of a stream of water being the cause of these erosions." What explanation will it be believed is offered for this fact?—It is, that the fine lines and furrows "must have resulted from the much greater facility which the ice had in dilating itself in the direction of the great Swiss valley, than transversely, confined as it were between the Jura and the Alps."!

I will now endeavour to show how far these very curious facts, which we owe to M. Agassiz's observation, can be explained by the theory of floating ice: and the theory, I may add, if applicable to this case, solves that which presents far greater difficulties, than any other of the kind in Europe. I should first state that I make two *assumptions*, and if these be rejected, the theory is not applicable to the case of the erratic blocks of the Alps:—first, that an arm of the sea extended between the Jura and the Alps, during that period in which, as I have before shown, it is probable, that the proportional area of water in Europe was greater, and certain, that the productions of the land and water had a more tropical character, at the same time that the snow-line descended lower. The age of the Molasse, which occupies this area, between the Jura and Alps, has not been accurately determined; but it is supposed to be miocene, and is said to contain leaves of the Chamærops, a genus of palms, at present found further from the equator than any other kind. It is not, however, evident that the Molasse was deposited by the sea during the latest period, when it occupied a confined limit between the Alps and Jura; but even if this should be found to be the case, it would be rash in any one positively to conclude that glaciers could not have descended to the shores of a sea, on which the Chamærops flourished, after that we know they descend in the southern hemisphere so near the limits of several tropical forms.

My second *assumption* is, that the elevation of this much of Switzerland, whenever it took place, was slow and gradual: this is supported by the strongest analogies of South America, Scandinavia, and other parts of the world; whilst on the other hand, the *assumption* that it had been sudden, would be unsupported by a single ascertained fact in nature. Now, as the numerous masses of ice, which fall from the glaciers at the head of the sounds on the South American coast, are slowly drifted outwards (owing to the fresh water flowing in from the foot of the glaciers), and in the more open channels are left to be acted on by the winds and currents; so must it have been with the icebergs from the glaciers of the Alps, situated in the same latitude, and under similar conditions. These icebergs would in most cases be driven on some part of the surrounding shore; but from floating deep they would ground a little way from the beach, and then being packed together, and driven to and fro, as the winds changed, and as the tides rose and fell, would they not, like a glacier on the land, though in a lesser degree, "bruise and grind down every thing and polish the solid surface, on which they reposed?" In the rapids of the North American rivers, over which large bodies of ice are driven, carrying with them pebbles and fragments of rocks, I am informed by Dr. Richardson, that the primitive rocks are scooped and hollowed, and have their surfaces polished and glossy. Dr. Richardson, however, is not prepared to say, whether this

is caused by the passage of the ice or of the pebbles.* Although the icebergs might be drifted from side to side of the sound, if they were moved after having grounded, it would be along the shore by the set of the currents or wind, and perhaps slightly up and down by the tidal changes. Would not the necessary effect of this be, that the scratches formed by the sand grating between the rocks and the bottom of the icebergs should be, with some irregularities, longitudinal, or (from the effect of the tidal movement) oblique? And as the mountains slowly emerged during ages, every part would be thus acted on; and consequently the whole surface would be marked by longitudinal scratches.

The icebergs on the South American coast sometimes transport angular fragments of rock, to the distance of many miles from the glacier whence they were detached; and as the winds and currents generally have sufficient steadiness to drive any floating object soon on shore, (as is known to be the case with a capsized boat, a barrel, or floating carcass, &c.), so the blocks of rock would be *generally*† landed on the shores of the chan-

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* It must be remembered, that I am here considering the effect of icebergs, in inland and protected sounds. Dr. Richardson tells me, that the great icebergs in the Arctic sea are packed together, and are driven with such force against the shore, that they push up before them, to the height of several feet, every pebble and boulder which lies on the bottom; and consequently the submarine ledges of rock are kept absolutely bare. If a fragment were to be wedged beneath one of these mountain-masses of ice, when forced upward with such overwhelming power, it is impossible to doubt that the underlying surface of solid rock would be deeply scored. As it is known that the shingle on most beaches has a tendency to travel in one direction, so must the icebergs; and hence we may conjecture, that the grooves, would generally be slightly oblique to the line of coast, and parallel to each other.

† We might expect that they would *sometimes* be launched into the deep, whilst on their passage. M. Charpentier (*Edinburgh New Phil. Journal*, vol. xxi., p. 217) observes, speaking of another theory, "This view is equally insufficient to account for the extraordinary position of immense single blocks, which we sometimes find planted vertically in the soil, in the *valleys*, as on the sides of a mountain, and split up throughout their whole extent from top to bottom,—a phenomenon which would force us to believe that these blocks, had fallen perpendicularly from a certain height on the very spots where we now see them, and had been rent asunder by the fall, into the several fragments lying near one another." M. Charpentier considers this owing to the fragments having fallen through fissures in the enormous glaciers, which, as he believes, extended from the Alps, across the lake of Geneva, and up the Jura. The explanation above suggested is, at least, as simple as this.

nels between the Alpine ranges, and not dropped in the intervening spaces. If any pointed rock came so near the surface that a floating mass of ice thus charged, grounded on it, the block would, when the ice melted, be there left. But it may be asked, would the blocks usually be deposited on the bare surface of the rocky bottom off the shore, or on an intervening layer of gravel or sediment? From what I have observed when passing in boats through the channels of Tierra del Fuego, and from frequent examinations of the armings of the lead used in sounding, I feel nearly sure that *absolutely bare* submarine rock is not very common. Moreover, where matter is depositing near a shore, the finer the particles are, the further they are drifted: in approaching a coast I have actually traced *every step in the series*, from the finest sand to large pebbles. But as the land in any case is slowly elevated, the same forces which carried the large pebbles to a certain distance from the beach, and the smaller ones to a still further distance, will, after each little elevation, carry them somewhat further:—a layer of little pebbles thus covering the sand, and a layer of large pebbles the smaller ones. Hence, when the part near the shore is converted into dry land, a section of the bed which was originally the bottom of the sea will necessarily show solid rock covered by sand, this by fine pebbles, and these again by others, gradually increasing in size. Such then, I conclude, must have been the nature of the sublittoral deposits of the Alps, during their assumed slow elevation. Finally, as icebergs of large size would seldom be driven up on the beach of a sheet of water, if, like the channel between the Jura and the Alps, it were protected from the open sea, any fragments of rock transported by them would have been dropped some way outside, and therefore when upraised with the whole country, they would be found in most cases reposing on beds (where the loose matter had not been subsequently removed), characterized by the order of superposition just described.

Such is the explanation I would suggest of the very curious facts observed by M. Agassiz. I make no assumptions which are not supported by strong analogies and the foundation of the theory—namely, a change of climate of a peculiar kind—can be shown by reasoning, independent of the existence of erratic blocks, to be probable in a high degree: whether this is the case with the theory of M. Agassiz, I leave the reader to decide.

Having said thus much on the scratched rocks of the Alps, I am tempted to make a few remarks on those of Scotland, described by Sir James Hall* in his celebrated paper (*Edinburgh Phil. Transact.*, vol. vii.)

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* Sir James Hall believes that erratic boulders were transported by debacles, when embedded in ice. He seems to have been led to this opinion, by a clear perception of the difficulty of supposing the existence

on the Revolutions of the Earth's Surface:—a case which has always appeared to me to be the strongest ever adduced in favour of the theory of an overwhelming debacle having rushed, at least in that country, over hill and valley. The furrows and scratches in the same district are parallel to each other, and hence run in the same direction:—thus, near Edinburgh, they extend in a line a little north of west and south of east, that is parallel to the valley of the estuary; but both to the eastward and westward they deviate from this line by more than half a right angle; and on the south-west part of Scotland they have no uniform direction. In the north of Scotland, however, near Brora, Mr. Murchison (*Geolog. Transact. 2d Series*, vol. ii., p. 357) found the hills marked in parallel lines, directed north-west and south-east. The furrows and scratches near Edinburgh seem generally to traverse the less inclined surfaces, but Sir James, speaking of one part, says "the *perpendicular* face as well as the rest is covered with lines, which are horizontal, or nearly so." In these respects the case appears very similar to that of the Alps: the rocks, however, are not polished;* but this may be owing to their nature, sandstone and trap, and not to any difference in the cause; for Dr. Richardson tells me that in the same rivers in North America, in which the granitic rocks are much polished, those of laminated limestone are not at all so. Near Edinburgh, where the lines extend west and east, the western face of the hills (of which the highest mentioned is four hundred and seventy feet above the sea) is chiefly marked, whilst on the opposite or protected side, a long tail of (so called) *diluvium* extends, which consists of blue clay, with large erratic boulders embedded in it. These boulders, as I am informed by Mr. James Hall, and by Mr. Smith of Jordanhill, are themselves marked with parallel lines, having one direction, which shows that they were held fast whilst drifted across the country, and not rolled over and over, like a pebble in a stream. It is

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of glaciers in the Alps and in other regions of central Europe, excepting at great altitudes; and from such situations a debacle was absolutely requisite to transport fragments on ice. Sir James rejects the belief of M. Wrede (given on the authority of De Luc), that the boulders of the Baltic may have been brought into their present place by ice, acting, during a steady and slow change in the level of the ocean. M. Wrede, therefore, appears to have been the originator of the theory advocated in this volume; and no country was more likely than Sweden to have given birth to such a theory.

* It is, however, said in Professor Buckland's *Reliquiæ Diluvianæ*, p. 202, that Colonel Imrie found the surface of some trap-rocks in the southern parts of Stirlingshire, having "a considerable degree of polish; and this polish is almost always seen marked by long linear scratches."

admitted by all that the grooves on the solid rock were formed by the passage of these boulders over it. Although the minor inequalities of the surface of the land appear to have had no influence whatever on the action which produced the scratches, yet the larger features, as the general bearing of the main valleys, appear to have determined their direction. Sir James distinctly states that the scoopings and furrows have precisely that form which the long action of torrents tends to produce on a solid rock; but he adds, and I believe most truly, that the furrowed surface produced by such means is smooth, and not deeply scored and scratched. It is indeed utterly inconceivable that large stones should be carried along as if "*independently of their gravity*" by any ordinary means, with such velocity, as to mark with horizontal lines the *perpendicular* face of a rock. From these facts,—from the presence of great erratic blocks, from the steepness of one face of the grooved hills, and the tail of sediment stretching out from the other, Sir James Hall, having in his mind the recorded cases of the great waves consequent on earthquakes, inferred that a vast deluge had burst over the country from the westward.

M. Brongniart, and lately M. Sefström (*L'Institut, February* 22d, 1837), have described phenomena in Sweden almost identical with those of Scotland. The rocks are there grooved and scratched,* even to the height of 1500 feet, in north and south lines, parallel to the valley of the Baltic and of the Gulf of Bothnia; but they are considerably deflected by the larger inequalities of surface. The north side of the hills are most affected, whilst from the southern side, long ridges, called *oasars*, stretch out; they are composed of sand and waterworn materials, and appear to be similar, but on a much larger scale, to the *tails of diluvium* in Scotland. In Sweden, however, the erratic blocks always lie on the surface of these ridges, and are not embedded within them: but M. Sefström says, that at the time when the grooves were formed, enormous masses of rock were torn from the mountains. In the United States, the phenomenon of the grooved rocks appears to be developed in an extraordinary manner. Pro-

* Mr. Lyell, moreover, describes (*Philosoph. Transact.*, 1835, p. 18), the rocks of gneiss on the beach near Oregrund in Sweden, as being so "smooth and polished, that it is difficult to walk on them." Further on (p. 21), he describes the large bodies of ice, which are annually packed on this coast, so as to be eighteen feet thick: here then we have the same phenomena as in the Alps; and great icebergs in movement, instead of solid glaciers. More lately M. Berzelius has sent specimens of these rocks, "polished as if by emery in a constant rectilinear direction" (*Edinb. New Phil. Journal*, vol. l., p. 313), to Paris, accompanied by a letter to M. Elie de Beaumont.

fessor Hitchcock (*Report on the Geolog. of Massachusetts*, p. 167) describes a tract about two hundred miles in width, over which nearly all the bare rock on the hills, even to the height of three thousand feet, is scored by parallel lines. In some parts boulders, weighing from fifty to one hundred tons, are yet lying on the surfaces, which bear the marks of their passage. The furrows are generally directed a little west of north, but in the western part of Massachusetts, and in the eastern of New York, they extend in a north-west and south-east line, and in one part even to W. 20° N. M. Sefström and Professor Hitchcock explain these appearances in their respective countries by the same agency, as Sir James Hall does in Scotland.

The theory of a great debacle is in these cases based on the united presence of erratic boulders, ridges of waterworn materials, forming tails to scarped hills, and parallel furrows and scratches on the surface of the rocks. 1st. With respect to the boulders, it would be superfluous to repeat the arguments in favour of the idea of their transportation by ice: and in the case of Sweden, it would be pre-eminently superfluous, as we know (see *Lyell on the Rising of the Land in Sweden, Phil. Transact.*, 1835) that blocks are there transported yearly by this means. 2d. Every one who has examined a great estuary, or a channel where the tides run strongly, is aware that linear banks are formed behind any obstacle. Therefore these tails of diluvium might have been formed, as far as regards their external form, by ordinary means; and with respect to their internal structure, which appears extremely irregular, and without any stratification, it must be difficult for any one to speak with certainty, until the joint effects of ice transporting coarse fragments and gentle currents of water, fine mud, are better known. Mr. Lyell, indeed (*Phil. Transact.*, 1835, p. 15) has advanced strong reasons, showing from the structure and composition of the *oasars* that they could not have been formed by any sudden debacle. Whilst such linear banks were depositing on one side of the hills, the other, or exposed front, would almost necessarily become scarped. 3d. We have the admission of Sir James Hall, that the scoopings and grooves resemble those produced by the slow action of running water: therefore the scratches appear to be the only part of the phenomenon which remains unexplained.

In the Alps, we are told, that scratches are formed on rocks by glaciers grinding over them. According to the theory of floating ice, we have evidence in the erratic blocks near Edinburgh, that ice was formerly in action there; and, from the analogies given in this volume, it might well have been so, since the scene of supposed action lies two degrees nearer the Pole than Georgia, in the southern ocean, "almost wholly covered with everlasting snow." What then would be the effect of the tides and gales of wind, driving packed icebergs with irresistible force, through chan-

nels, and over rocky shoals ;—each part of the surface being exposed for centuries, as the country was elevated, to this action? Would not the fragments of rock embedded in the ice grate in a direct path over the surface, regardless of *minor inequalities?* and would not the fragments themselves be grooved and scored in one direction? Can we for one moment believe it possible that boulders, either in water or in the thickest mud, could be driven over a rugged surface, or along a perpendicular face of solid rock, with such enormous velocity as with their points to groove and scratch it, and nevertheless not to be rolled over and over, like a stone descending a mountain, but to be marked with parallel lines of abrasion, equally with the fixed, underlying mass? It appears to me that we assuredly can make no such admission. Travellers in the Arctic regions tell us that the drift-ice, with its irresistible power, can force up the gravel and sand into mounds (see *Geograph. Journal*, vol. viii., p. 221), and drive before it great boulders, and even ships, and masses of ice, high and dry on the beach. What then would be the effect of a few pebbles, or a single fragment, between such masses of ice and a steep coast-wall of rock? Would not scratches "horizontal, or nearly so" be formed, "indicating (to use Sir James Hall's words) that grinders had been pressed against the rock;" as if "independently of their gravity"?

In this explanation only *veræ causæ* are introduced, and reasons can be assigned, for the belief that these causes have been in action in these districts. On the theory of debacles, it still remains to be proved that rocks can be thus *scooped* and *furrowed*, or hills *scarped;* although I am far from affirming they cannot,—and scratched, I presume, they certainly would be. With respect to Sweden, where the land is now rising, and where ice even still is a transporting agent, it is undoubtedly the part of the geologist, to endeavour by long and laborious research to account for the phenomena by these real agencies. For to introduce, before it is absolutely forced on us, the hypothesis of a deluge of mud and stones, fifteen hundred feet deep in Sweden, or three thousand in North America, which rushing over the country, rounded the northern fronts of the hills, and rolling by their eastern and western flanks, left them marked with oblique furrows, is to violate, as it appears to me, every rule of inductive philosophy.

Page 297.

With reference to the embedment of the Siberian animals with their flesh, I have mentioned in a note, the case of ice described as rising from the bottom of the sea, off the coast of Greenland. Messrs. Dease and Simpson, during their late memorable journey along the shores of the Arctic ocean, speaking of one part (*Geograph. Journal*, vol. viii., p. 218)

say, "The ice lay much closer here; and numerous masses adhered to the bottom, under the water, which obliged us to search a passage out from the shore." Further on (p. 220) they say, "But nowhere had the thaw penetrated more than two inches beneath the surface (of the land), while under water along the shore, the bottom was still *impenetrably frozen*." This was on the second of August. It should, however, be observed, that the sea along this part of the American coast is extremely shallow.

Page 321.

I have given my reasons for believing that the temperature of the mineral springs of Cauquenes, was permanently changed by the earthquake of 1822. This inference is altogether false, for I find that Schmidtmeyer, in his Travels in Chile during the years 1820 and 1821, says (p. 311) that the temperature of the different springs was 83°, 103°, 106°, 112°, 117° and 118° of Fahrenheit. Now Mr. Caldcleugh says, after the earthquake of February, 1835, the temperature fell from 118° to 92°. Previously, therefore, to this shock, it had regained the temperature which it had in 1820.

Page 377.

When I offered my views on the cause of the great waves, which follow earthquakes on certain coasts, I was not aware of the paper on this subject by Sir James Hall in the *Edinburgh Royal Transactions*, vol. vii., p. 154. I cannot, however, perceive the necessity of a sudden elevation of the bottom, to produce the observed effects, as supposed by that distinguished philosopher. Having read the abstract of a *Notice on the Resistance of Water*, by Mr. Russell, I perceive the subject is far more intricate, than I was at the time aware.

Page 381.

I have said that during the *few months* subsequently to the great shock of February, 1835, at Concepcion, upwards of three hundred tremours were felt, but I should have said, within *twelve days*. (See *Geograph. Journal*, vol. vi., p. 322. *Sketch of Surveying Voyage of the Adventure and Beagle, by Captain FitzRoy*). From some additional information which I have met with since finishing this chapter, I find the train of volcanic phenomena, which followed this earthquake, affected a larger area than that mentioned (seven hundred by four hundred miles), and affected it in a manner which gives great additional weight to the argument that South America is in that part a mere crust resting over a sheet of fluid rock;

and likewise to the generalization that the action of volcanoes, and the permanent elevation of the land (and consequently, as I believe, the elevation of mountain chains) are parts of the same phenomenon, and due to the same cause.

Page 446.

When I put together the few and exceedingly imperfect remarks on the subject of Miasmata, I did not know of Dr. Ferguson's remarkable dissertation—the result of his investigations in Holland, Spain, Portugal, and the West Indies—on the Nature and History of Marsh Poison (*Edinburgh Royal Transact.*, vol. ix., p. 273). He there clearly proves the fact, which had struck me with so much surprise, namely, that the driest districts, which, according to common notions, would be considered as the most healthy, are often singularly the contrary. In his concluding remarks, Dr. Ferguson says (p. 290), " One only condition, then, seems to be indispensable to the production of the marsh poison, on all surfaces capable of absorption, and that is the *paucity* of water, where it has previously or recently *abounded*. To this there is no exception in climates of high temperature; and from thence we may justly infer, that the poison is produced at a highly advanced stage of the *drying process*." And, from facts previously stated, it would appear that even in barren hilly countries, the banks of mountain torrents, which had been overflowed, sometimes became extremely insalubrious. In another place, Dr. Ferguson says, " It is from these (the dried and half-dried margins of lakes and marshes) that the poison uniformly emanates, and never from the body of the lake or pool; and I think it may be fairly presumed, that water, as long as it can preserve the figure of its particles above the surface, is innoxious, and that it must first be absorbed into the soil, and disappear from the eye, before it can produce any mischievous effects. Whoever in malarious countries waits for the evidence of putrefaction will, in all the most dangerous places, wait too long, as every one can testify who has seen pestilence teem forth, to the paralyzation of armies,—from the bare barren sands of the Alentejo in Portugal, the arid burnt plains of Estremadura in Spain, and the recently flooded table-lands of Barbadoes." I cannot forbear quoting here a remarkable fact, mentioned by Humboldt, though interpreted in a different manner by that illustrious traveller. Speaking of the intermittent fevers which are so common near the great cataracts, or *raudales*, of the Orinoko, he says (*Pers. Nar.*, vol. v., p. 17) the causes " are violent heats, joined with the excessive humidity of the air, bad nutriment, and, if we may believe the natives (as well as the missionaries), the pestilent exhalations that arise from the bare rocks of the *raudales*." Further on (p. 85), he says, " many examples are adduced of persons, who

having passed the night on these black and naked rocks, have awakened in the morning with a strong paroxysm of fever." Humboldt thinks that these cases may be explained by the effect produced on the body by the high temperature, which the black rocks, coated with a layer of the oxides of manganese and iron, retain during the night. But it appears to me that the relation is too remarkable to be thus explained, between this fact and those mentioned by Dr. Ferguson, in which the desiccation of nearly bare rock in Spain, and of a very thin bed of earth overlying dry coral-rock in the West Indies, has given rise to the most pestiferous exhalations.

Page 461.

The sixth bird, mentioned as an inhabitant of the Galapagos, Mr. Gould now finds is not like the rest, peculiar to these islands, but is a known North American species of Ammodramus.

Page 465.

I have given my reason for believing that the *Testudo*, inappropriately called *Indicus*, is an aboriginal species of the Galapagos. I now find (*Kerr's Voyages*, vol. x., p. 373) that as far back as 1708, Woods, Rogers, and Courtney, in their voyage round the world, speaking of the tortoises of these islands, say that it is the opinion of the *Spaniards* that there is no other in *these seas*, except at the Galapagos: it is, however, then added, that they are common in Brazil,—a mistake which may be attributed to two different species not having been distinguished. It has been said that the bones of *Testudo Indicus* were found in numbers in the Isle of France, with some fragments of those of the Dodo; but M. Bibron—one of the best authorities in Europe on reptiles—informs me that he has reason to believe that a second species has been confounded under this name.

In the same page I remark that there is every reason for believing that several of the islands possess their own peculiar varieties or species of tortoise, but that my specimens were too small to decide this question. M. Bibron now informs me, that he has seen full-grown animals, brought from this Archipelago, which he considers undoubtedly to be distinct species. At p. 467, I have observed that the specimens of the *Amblyrhyncus cristatus*—that extraordinary marine herbivorous lizard—were larger from Albemarle, than from any other island. In this case, also, M. Bibron tells me, he has seen what he considers two species of the aquatic Amblyrhyncus, besides the terrestrial species. Doubtless the several islands have their own representatives of the Amblyrhyncus, like

they have of some of the birds, and of the tortoises. With respect to the plants from this Archipelago, Professor Henslow writes to me, that although he has not yet examined them attentively, he finds that "there are several instances of distinct species of the same genus, sent from one island only: that is, whilst the genus is common to two or three islands, the species are often different in the different islands. In some cases the species seem to run very close to each other, but are, I believe, *distinct*." I may observe that, from my ignorance of botany, I collected more blindly in this department of natural history than in any other; so that certainly it was not *intentionally* that I brought the different species from different islands. If, indeed, I at all noticed their resemblance, I probably collected the second and third species as duplicate specimens of the first. It is useless to repeat here my regrets at not having procured a perfect series in every order of nature from the several islands: my excuse must be, the entire novelty of the fact, that islands in sight of each other should be characterized by peculiar faunas: I ought, perhaps, rather to think it fortunate, that sufficient materials were obtained to establish so remarkable a circumstance in the geographical distribution of organic beings, although they are insufficient to determine to what extent the fact holds good.

Page 477.

To the two cases of land-birds being extremely tame in islands only lately inhabited by man, I might have added Tristan da Acunha. Captain D. Carmichael (*Linn. Transact.*, vol. xii., p. 496), speaking of the thrush and bunting—the only true land-birds—says, "they fly about the cantonment, and are so tame as to suffer themselves to be caught with a hand-net."

Page 552.

One of the species of Millepora, which is mentioned as having the property of stinging, is the *M. complanata;* and the other, I believe, is *M. alcicornis*. In the Voyage of the Astrolabe (vol. iv., p. 19), an Actinia is said to have this property, and even to infect the water, which it squirts from its mouth. A flexible coralline, allied to Sertularia, was observed (p. 337) at New Ireland to have the same stinging power.

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TO

MR. DARWIN'S JOURNAL.

THE END.

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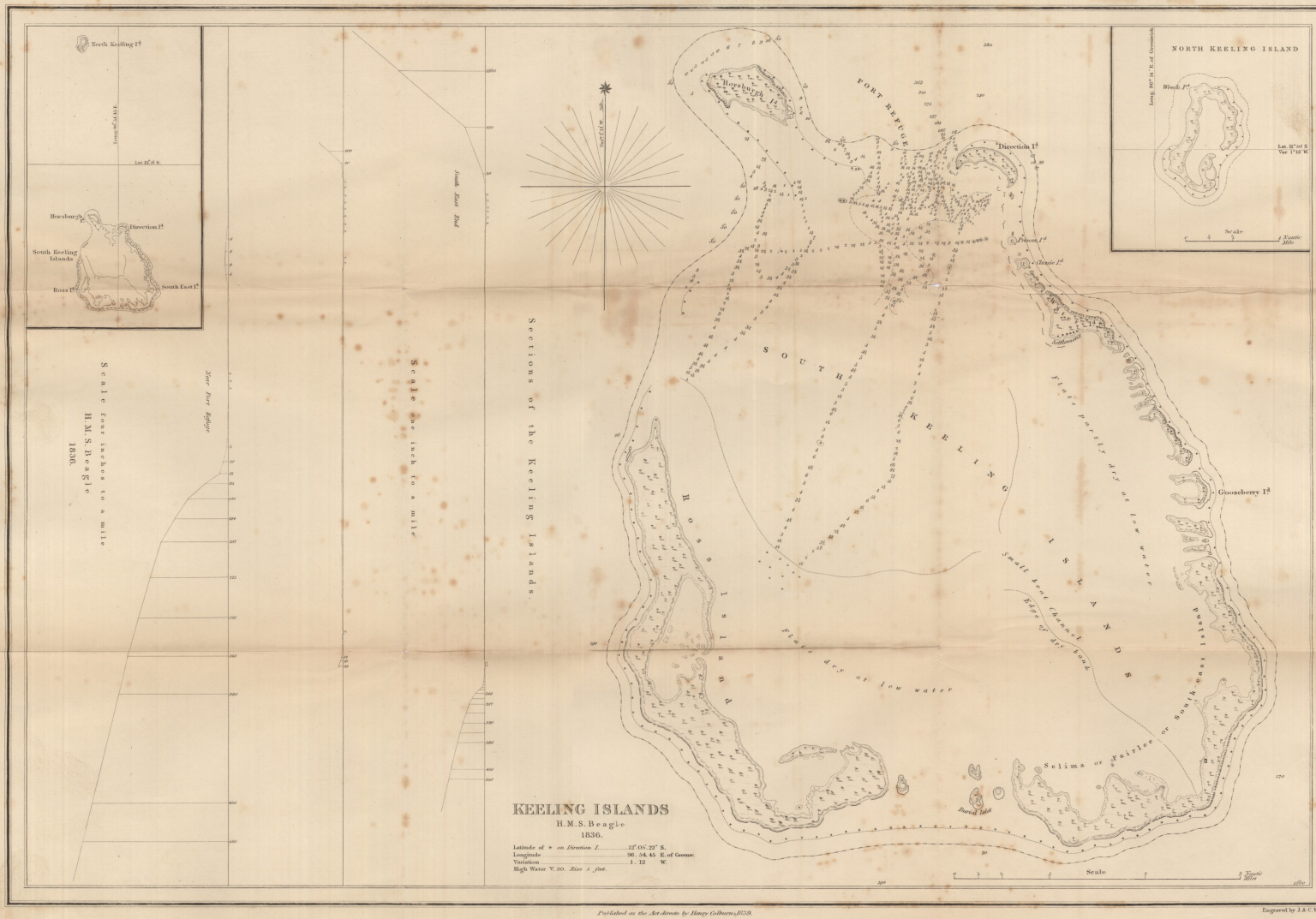

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