CHAPTER XV.

Valparaiso—Portillo pass—Sagacity of mules—Mountain-torrents—Mines, how discovered—Proofs of the gradual elevation of the Cordillera—Effect of snow on rocks—Geological structure of the two main ranges, their distinct origin and upheaval—Great subsidence—Red snow—Winds—Pinnacles of snow—Dry and clear atmosphere—Electricity—Pampas—Zoology of the opposite sides of the Andes—Locusts—Great Bugs—Mendoza—Uspallata Pass—Silicified trees buried as they grew—Incas Bridge—Badness of the passes exaggerated—Cumbre—Casuchas—Valparaiso.

PASSAGE OF THE CORDILLERA.

March 7th, 1835.—We stayed 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 keep quiet, whilst he listened for the breakers. Captain Fitz Roy 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 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 part of Chile there are two passes across the Andes to Mendoza: the one most commonly used—namely, that of Aconcagua or Uspallata—is situ-

ated some way to the north; the other, called the Portillo, is to the south, and nearer, but more lofty and dangerous.

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 Maypu, 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—their boughs 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 the mountains are quite impassable in other parts by beasts of burden. 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 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 at the time much pleased: 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 or higher 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 a cloudless sky, and knew no trouble. My companions were Mariano Gonzales, who had formerly accompanied me in Chile, 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 wherever she goes, the mules, like good children, follow her. The affection of these animals for their madrinas saves infinite trouble. If several large troops

are turned into one field to graze, in the morning the muleteers have only to lead the madrinas a little apart, and tinkle their bells; and although there may be two or three hundred together, each mule immediately knows the bell of its own madrina, and comes to her. 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 a madrina. In a troop each animal carries on a level road, a cargo weighing 416 pounds (more than 29 stone), but in a mountainous country 100 pounds less; yet with what delicate slim limbs, without any proportional bulk of muscle, these animals support so great a burden! The mule always appears to me a most surprising animal. That a hybrid should possess more reason, memory, obstinacy, social affection, powers of muscular endurance, and length of life, than either of its parents, seems to indicate that art has here outdone 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 main valleys in the Cordillera are characterised by having, on both sides, a fringe or terrace of shingle and sand, rudely stratified, and generally of considerable thickness. These fringes evidently once extended across the valleys, and were united; and the bottoms of the valleys in northern Chile, where there are no streams, are thus smoothly filled up. On these fringes the roads are generally carried, for their surfaces are even, and they rise with a very gentle slope up the valleys: hence, also, they are easily cultivated by irrigation. They may be traced up to a height of between 7000 and 9000 feet, where they become hidden by the irregular piles of debris. At the lower end or mouths of the valleys, they are continuously united to those land-locked plains (also formed of shingle) at the foot of the main Cordillera, which I have described in a former chapter as characteristic of the scenery of Chile, and which were undoubtedly

deposited when the sea penetrated Chile, as it now does the more southern coasts. No one fact in the geology of South America, interested me more than these terraces of rudely-stratified shingle. They precisely resemble in composition, the matter which the torrents in each valley would deposit, if they were checked in their course by any cause, such as entering a lake or arm of the sea; but the torrents, instead of depositing matter, are now steadily at work wearing away both the solid rock and these alluvial deposits, along the whole line of every main valley and side valley. It is impossible here to give the reasons, but I am convinced that the shingle terraces were accumulated, during the gradual elevation of the Cordillera, by the torrents delivering, at successive levels, their detritus on the beach-heads of long narrow arms of the sea, first high up the valleys, then lower and lower down as the land slowly rose. If this be so, and I cannot doubt it, the grand and broken chain of the Cordillera, instead of having been suddenly thrown up, as was till lately the universal, and still is the common opinion of geologists, has been slowly upheaved in mass, in the same gradual manner as the coasts of the Atlantic and Pacific have risen within the recent period. A multitude of facts in the structure of the Cordillera, on this view receive a simple explanation.

The rivers which flow in these valleys ought rather to be called mountain-torrents. Their inclination is very great, and their water the colour of mud. The roar which the Maypu 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 from 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, made the one dull uniform sound, were all hurrying in one direction. It was like thinking on time, where the minute that now glides past is irrecoverable. So was it with these stones; the ocean is their eternity, and each note of that wild music told of one more 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 conveys an idea, not more definite than the

savage implies 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 and produced 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 face of the earth, and that during this whole period, 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 were from 3000 to 6000 or 8000 feet high, with rounded outlines and steep bare flanks. The general colour of the rock was dullish purple, and the stratification very distinct. If the scenery was not beautiful, it was 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 geologising. 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 marvels how mines have been discovered in such extraordinary situations, 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 wear 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 search 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 discovered by a man who threw a stone at his loaded donkey, and thinking that it was very heavy, he picked it up, and found it full of pure silver: the vein occurred at no great distance, standing up like a wedge of metal. The miners, also, taking a crowbar with them, often wander on Sundays over the mountains. In this 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 discoverers.

20th.—As we ascended the valley, the vegetation, with the exception of a few pretty alpine flowers, became exceedingly scanty; and of quadrupeds, birds, 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. The features in the scenery of the Andes which struck me most, as contrasted with the other mountain chains with which I am acquainted, were,—the flat fringes sometimes expanding into narrow plains on each side of the valleys,—the bright colours, chiefly red and purple, of the utterly bare and precipitous hills of porphyry,—the grand and continuous wall-like dikes,—the plainly-divided strata which, where nearly vertical, formed the picturesque and wild central pinnacles, but where less inclined, composed the great massive mountains on the outskirts of the range,—and lastly, the smooth conical piles of fine and brightly-coloured detritus, which sloped up at a high angle from the base of the mountains, sometimes to a height of more than 2000 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. The case appears to me rather obscure: for that part of the mountain which is protected by a mantle of snow, must be less subject to repeated and great changes of temperature than any other part. I have sometimes thought, that the earth and fragments of stone on the surface, were perhaps less effectually removed by slowly percolating snow-water† than by rain, and therefore that the appearance of a quicker disintegration of the solid rock under the snow, was deceptive. Whatever the cause may be, the quantity of crumbling stone on the Cordillera is very great. Occasionally in 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. D'Orbigny (tom. 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.

spring, great masses of this detritus slide down the mountains, and cover the snow-drifts in the valleys, thus forming natural ice-houses. We rode over one, the height of which was far below the limit of perpetual snow.

As the evening drew to a close, we reached a singular basin-like plain, called the Valle del Yeso. It was covered by a little dry pasture, and we had the pleasant sight of a herd of cattle amidst the surrounding rocky deserts. The valley takes its name of Yeso from a great bed, I should think at least 2000 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. We set out early in the morning (21st), and continued to follow the course of the river, which had become very 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 up the great range, dividing the republics of Chile and Mendoza.

I will here give a very brief sketch of the geology of the several parallel lines forming the Cordillera. Of these lines, there are two considerably higher than the others; namely, on the Chilian side, the Peuquenes ridge, which, where the road crosses it, is 13,210 feet above the sea; and the Portillo ridge, on the Mendoza side, which is 14,305 feet. The lower beds of the Peuquenes ridge, and of the several great lines to the westward of it, are composed of a vast pile, many thousand feet in thickness, of porphyries which have flowed as submarine lavas, alternating with angular and rounded fragments of the same rocks, thrown out of the submarine craters. These alternating masses are covered in the central parts, by a great thickness of red sandstone, conglomerate, and calcareous clay-slate, associated with, and passing into, prodigious beds of gypsum. In these upper beds shells are tolerably frequent; and they belong to about the period of the lower chalk of Europe. It is an old story, but not the less wonderful, to hear of shells which were once crawling on the bottom of the sea, now standing nearly 14,000 feet above its level. The lower beds in this great pile of strata, have been dislocated, baked, crystallized and almost blended together, through the agency of mountain masses of a peculiar white soda-granitic rock.

The other main line, namely, that of the Portillo, is of a totally different formation: it consists chiefly of grand bare pinnacles of a red potash-granite, which low down on the western flank are covered by a sandstone, converted by the former heat into a quartz-rock. On the quartz, there rest beds of a conglomerate several thousand feet in thickness, which have been upheaved by the red granite, and dip at an angle of 45° towards the Peuquenes line. I was astonished to find that this conglomerate was partly composed of pebbles, derived from the rocks, with their fossil shells, of the Peuquenes range; and partly of red potashgranite, like that of the Portillo. Hence we must conclude, that both the Peuquenes and Portillo ranges were partially upheaved and exposed to wear and tear, when the conglomerate was forming; but as the beds of the conglomerate have been thrown off at an angle of 45° by the red Portillo granite (with the underlying sandstone baked by it), we may feel sure, that the greater part of the injection and upheaval of the already partially formed Portillo line, took place after the accumulation of the conglomerate, and long after the elevation of the Peuquenes ridge. So that the Portillo, the loftiest line in this part of the Cordillera, is not so old as the less lofty line of the Peuquenes. Evidence derived from an inclined stream of lava at the eastern base of the Portillo, might be adduced to show, that it owes part of its great height to elevations of a still later date. Looking to its earliest origin, the red granite seems to have been injected on an ancient pre-existing line of white granite and mica-slate. In most parts, perhaps in all parts, of the Cordillera, it may be concluded that each line has been formed by repeated upheavals and injections; and that the several parallel lines are of different ages. Only thus can we gain time, at all sufficient to explain the truly astonishing amount of denudation, which these great, though comparatively with most other ranges recent, mountains have suffered.

Finally, the shells in the Peuquenes or oldest ridge, prove, as before remarked, that it has been upraised 14,000 feet since a Secondary period, which in Europe we are accustomed to consider as far from ancient; but since these shells lived in a moderately deep sea, it can be shown that the area now occupied by the Cordillera, must have subsided several thousand feet—in northern Chile as much as 6000 feet—so as to have allowed that amount of submarine strata to have been heaped on the bed on which the shells lived. The proof is the

same with that by which it was shown, that at a much later period since the tertiary shells of Patagonian lived, there must have been there a subsidence of several hundred feet, as well as an ensuing elevation. Daily it is forced home on the mind of the geologist, that nothing, not even the wind that blows, is so unstable as the level of the crust of this earth.

I will make only one other geological remark: although the Portillo chain is here higher than the Peuquenes, the waters, draining the intermediate valleys, have burst through it. The same fact, on a grander scale, has been remarked in the eastern and loftiest line of the Bolivian Cordillera, through which the rivers pass: analogous facts have also been observed in other quarters of the world. On the supposition of the subsequent and gradual elevation of the Portillo line, this can be understood; for a chain of islets would at first appear, and, as these were lifted up, the tides would be always wearing deeper and broader channels between them. At the present day, even in the most retired Sounds on the coast of Tierra del Fuego, the currents in the transverse breaks which connect the longitudinal channels, are very strong, so that in one transverse channel even a small vessel under sail was whirled round and round.

About noon we began the tedious ascent of the Peuquenes ridge, and then for the first time experienced some little difficulty in our respiration. The mules would halt every fifty yards, and after resting for a few seconds the poor willing animals 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. The only sensation I experienced was a slight tightness across the head and chest, like that felt on leaving a warm room and running quickly in frosty weather. There was some imagination 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 extremely great, and the respiration became deep and laborious: I am told that in Potosi (about 13,000 feet above the sea) strangers do not become thoroughly 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 descending string of the animals; 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, was impetuous and extremely cold. On each side of the ridge we had to pass over broad bands of perpetual snow, which 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 no one could have imagined. Neither plant nor bird, excepting a few condors wheeling around the higher pinnacles, distracted my attention from the inanimate mass. I felt glad that I was alone: it was like watching a thunderstorm, or hearing in full orchestra a chorus of the Messiah.

On several patches of the snow I found the Protococcus nivalis, or red snow, so well known from the accounts of Arctic navigators. My attention was called to it, by observing the footsteps of the mules stained a pale red, as if their hoofs had been slightly bloody. I at first thought that 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 microscopical plants appeared like coarse particles. The snow was coloured only where it had thawed very rapidly, or had been accidentally crushed. A little rubbed on paper gave it a faint rose tinge mingled with a little brick-red. I afterwards scraped some off the paper, and found that it consisted of groups of little spheres in colourless cases, each the thousandth part of an inch in diameter.

The wind on the crest of the Peuquenes, as just remarked, is generally impetuous and very cold: it is said* to blow steadily from the westward or Pacific side. As the observations have been chiefly made

* Dr. Gillies in Journ. of Nat. and Geograph. Science, Aug. 1830. This author gives the heights of the Passes.

in summer, this wind must be an upper and return current. The Peak of Teneriffe, with a less elevation, and situated in lat. 28°, in like manner falls within an upper 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 earth's rotation. At Mendoza, on the eastern foot of the Andes, the climate is said to be subject to long calms, and to frequent 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 a mountainous country, intermediate between the two main ranges, and then took up our quarters for the night. We were now in the republic of Mendoza. The elevation was probably not 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 ranges. 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. 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 lower temperature than it

does in a less lofty country; the case being the converse of that of a Papin's digester. Hence 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 22nd.—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 guanacos had decamped, knowing well that if overtaken here 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, in the midst of which there was a blue patch, no doubt a glacier;—a circumstance of rare occurrence 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; in the valleys there were several broad fields of perpetual snow. These frozen masses, during the process of thawing, had in some parts been converted into pinnacles or columns,* which, as they were high and close together, made it difficult for the cargo mules to pass. On one of these columns of ice, a frozen horse was sticking as on a pedestal, but with its hind legs straight up in the air. The animal, I suppose, must have fallen with its head downward into a hole, when the snow was continuous, and afterwards the surrounding parts must have been removed by the thaw.

When nearly on the crest of the Portillo, we were enveloped in a falling cloud of minute frozen spicula. This was very unfortunate, as it continued the whole day, and quite intercepted our view. The

* This structure in frozen snow was long since observed by Scoresby in the icebergs near Spitzbergen, and lately, with more care, by Colonel Jackson (Journ. of Geograph. Soc., vol. v. p. 12) on the Neva. Mr. Lyell (Principles, 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, that in the case of the frozen snow, the columnar structure must be owing to a "metamorphic" action, and not to a process during *deposition*.

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 uninterruptedly extend to the Atlantic Ocean, 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 met here 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 over a deep crevice: one morning, 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 the transparency of the air confounding objects at different distances, and likewise partly 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 high state of atmospheric dryness. This dryness was shown by the manner in which woodwork shrank (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 had perished 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 23rd.—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 al-

pine country of Chile. A level and brilliantly white sea of clouds was stretched out beneath our feet, shutting 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 at 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 much struck with the marked difference between the vegetation of these eastern valleys and those on the Chilian side: yet the climate, as well as the kind of soil, is nearly the same, 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. I may instance the mice, of which I obtained thirteen species on the shores of the Atlantic, and five on the Pacific, and not one of them is identical. We must except all those species, which habitually or occasionally frequent elevated mountains; and certain birds, which 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 the present races of animals have appeared; and therefore, unless we suppose the same species to have been created in two different places, we ought not to expect any closer similarity between the organic beings on the opposite sides of the Andes, than on the opposite shores of the ocean. In both cases, we must leave out of the question those kinds which have been able to cross the barrier, whether of solid rock or saltwater.*

A great number of the plants and animals were absolutely the same as, or most closely allied to 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

* This is merely an illustration of the admirable laws, first laid down by Mr. Lyell, on 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 difference in the species in the two regions, might be considered as superinduced during a length of time.

some, I believe, on rigorous examination, absolutely identical. It had always been to me a subject of regret, that we were unavoidably compelled to give up the ascent of the S. 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 a mountainous 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 it much resembled a distant view of the ocean, but in the northern parts many irregularities were soon distinguishable. The most striking feature consisted in the rivers, which, facing the rising sun, glittered like silver threads, till lost in the immensity of the distance. At midday 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 thoroughbred 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 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 hills, 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 appearing narrow, must be nearly ten miles wide before it blends into the apparently dead level Pampas. We passed the only house in this neighbourhood, 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 fell, a circumstance which 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. Little water flows from the mountains, and it 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 of the Cordillera, 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, which are common near Bahia Blanca. The landscape has a uniform 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 inland from this river, in a sweeping line as far as San Luis, and perhaps even further north. To the eastward of this curved line, lies the basin of the comparatively damp and green plains of Buenos Ayres. The sterile plains of Mendoza and Patagonia consist of a bed of shingle, worn smooth and accumulated by the waves of the sea; while the Pampas, covered by thistles, clover, and grass, have been formed by the ancient estuary mud of the Plata.

After our two days' tedious journey, it was refreshing to see in the distance the rows of poplars and willows growing round the village and river of Luxan. Shortly before we arrived at this place, we observed to the south a ragged cloud of a dark reddish-brown colour. At first we thought that it was smoke from some great fire on the plains; but we soon found that it was a swarm of locusts. They were flying northward; and with the aid of a light breeze, they overtook us at a rate 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; "and the sound of their wings was as the sound of chariots of many horses running to battle:" or rather, I should say, like a strong breeze passing 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 together, but that they could escape a

stick waved backwards and forwards. When they alighted, they were more numerous than the leaves in the field, and the surface became reddish instead of being green: the swarm having once alighted, the individuals flew from side to side in all directions. Locusts are not an uncommon pest in this country: already during this season, several smaller swarms had come up from the south, where, as apparently in all other parts of the world, they are bred in the deserts. The poor cottagers in vain attempted by lighting fires, by shouts, and by waving branches to avert the attack. This species of locust closely resembles, and perhaps is identical with the famous Gryllus migratorius of the East.

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 not evaporated and lost. We slept in the village of Luxan, which is a small place surrounded by gardens, and forms the most southern cultivated district in 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 they become round and bloated with blood, and in this state are easily crushed. One which I caught at Iquique, (for they are found in Chile and Peru,) was very empty. When placed on a table, and though surrounded by people, if a finger was presented, the bold insect would immediately protrude 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 in less than ten minutes it changed 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, it 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, owes its fertility entirely to artificial irrigation; and it is really wonderful to observe how extraordinarily productive a barren traversia is thus rendered.

We stayed 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 with that of Santiago; but to those who, coming from Buenos Ayres, have just crossed the unvaried Pampas, the gardens and orchards must appear delightful. Sir F. 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 Sir F. 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 situated north 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 nearly three thousand feet above the sea, the sun was very powerful; and the heat, as well as the clouds of impalpable dust, rendered the travelling extremely irksome. Our course during the day lay nearly parallel to the Cordillera, 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, where a little higher up the house of Villa Vicencio is situated. As we had ridden all day without a drop of water, both our mules and selves 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 appeared; 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 stayed 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 main Cordillera by a long narrow plain or basin, like those so often mentioned in Chile, but higher, being six thousand feet above the sea. This range has nearly the same geographical position with respect to the Cordillera, which the gigantic Portillo line has, but it is of a totally different origin: it 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 tertiary 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 of about seven thousand feet, I observed on a bare slope 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 group. Mr. Robert Brown has been kind enough to examine the wood: he says it belongs to the fir tribe, partaking of the character of the Araucarian family, but with some curious points of affinity with the yew. The volcanic sandstone in which the trees 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. I saw the spot where a cluster of fine trees once waved their branches on the shores of the Atlantic, when that ocean (now driven back 700 miles) came to the foot 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 subsequently this dry land, with its upright trees, had been let down into the depths of the ocean. In these depths, the formerly dry land was covered by sedimentary beds, and these again by enormous streams of submarine lava—one such mass attaining the thickness of a thousand feet; and these deluges of molten stone and aqueous deposits five times alternately had been spread out. The ocean which received such thick masses, must have been profoundly deep; but again the subterranean forces exerted themselves, and I now beheld the bed of that ocean, forming a chain of mountains more than seven thousand feet in height. Nor had those antagonist forces been dormant, which are always at work wearing down the surface of the land: 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 the Cordillera itself is absolutely modern as compared with many of the fossiliferous strata of Europe and 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 of colour, 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 appeared larger than in the low country, as was the case with the rivulet of Villa Vicencio. 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 formed by the melting of the snow, 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 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 are 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 can be seen. In the course of this day we crossed some of the worst passes in the Cordillera, but their danger has been much exaggerated. I was told that if I attempted to pass on foot, my head would turn giddy, and that there was no room to dismount; 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 this there is little chance. 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 saw, I suspect the real danger is nothing. 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 precipices. In crossing the rivers I can well believe that the difficulty may be very great: at this season there was little trouble, but in the summer they must be very hazardous. I can quite imagine, as Sir F. 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 it frequently happens. The arriero tells you to show your mule the best line, and then allow her to cross as she likes: the cargo-mule takes a bad line, and is often lost.

April 4th.—From the Rio de las Vacas to the Puente del Incas, half a day's journey. As there was pasture for the mules, and geology for me, we bivouacked here 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 Incas 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 met by earth and stones falling down from the opposite cliff. Certainly an oblique junction, as would happen in such a 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.

5th.—We had a long day's ride across the central ridge, from the Incas Bridge to the Ojos del Agua, which are situated near the lowest *casucha* on the Chilian side. These casuchas are round little towers, with steps outside to reach the floor, which is raised some feet above the ground on account of the snow-drifts. They are eight in number, and under the Spanish government were kept 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; its height, according to Mr. Pentland, is 12,454 feet. The road did not pass over any perpetual snow, although there were patches of it on both hands. The wind on the summit was exceedingly cold, but it was impossible not to stop for a few minutes to admire, again and again, the colour of the heavens, and the brilliant transparency of the atmosphere. The scenery was grand: to the westward there was a fine chaos of mountains, divided by profound ravines. Some snow generally falls before this period of the season, and it has even happened that the Cordillera have been finally closed by this time. But we were most fortunate. The sky, by night and by day, was cloudless, excepting 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 far-distant mountains 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 Chil-

ian character: the lower sides of the mountains, dotted over with the pale evergreen Quillay tree, and with the great chandelier-like cactus, are certainly more to be admired than 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 and of a good supper, after escaping from the cold regions above: and I am sure I most heartily participated in these feelings.

8th.—We left the valley of the 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 delightful: the autumn being 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 I missed that pensive stillness which makes the autumn in England indeed the evening of the year. On the 10th we reached Santiago, where I received 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.