EXPLORATIONS IN PATAGONIA.*

By Dr. Francisco P. Moreno.

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I.

Our President lately recalled the fact that vast areas existed in South America still unknown to geography, which were not only interesting on account of the rich products they may be presumed to contain, but also for the variety, beauty, and charm of their landscapes. This certainly referred, amongst other regions, to certain parts of the Argentine Republic, and particularly to Patagonia.

As a matter of fact, up to quite recent times, the geography of the southern portion of the New World has been in a very backward state. Since the memorable hydrographical expeditions of the *Adventure* and the *Beagle*, supplemented later on by those of the *Nassau* and the *Maine*, we can only remember the Chilian investigations in Chiloe and Guaitecas and on the western coast of Patagonia. With reference to the interior of the latter country south of parallel 40°, the little that was known up to 1870 was derived from Argentine or Chilian surveys of very limited areas, and since the discovery of the Chubut river by the *Beagle* expedition, and the exploration of the river Santa Cruz, in which Charles Darwin took part, the maps of Patagonia have presented no new feature; its fluvial system was taken from the ancient Spanish charts, and of its numerous lakes only some three or four were indicated, and even then their exact position remained undecided.

It was not until 1869-70 that George Chaworth Musters crossed Patagonia from end to end for the first time, in the company of some Tehuelchian Indians, on one of their periodical migrations; but,

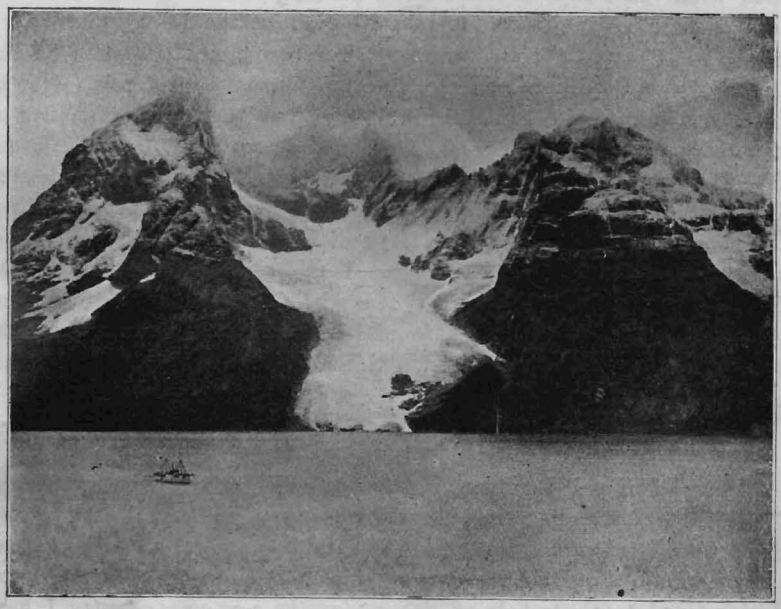
* Read in part at the Royal Geographical Society, May 29, 1899. Map, p. 54. A map on a much larger scale will be published in a future number of the *Geographical Journal*.

unfortunately, owing to the mode of life he had to follow, and the route chosen by the Indians—the easiest and the one most abounding with game, but still the least interesting one—his narrative, although it constitutes a picture full of life and interest, by the description of the customs of his fellow-travellers and of the general aspect of the landscape, contains little of a concrete or new character from a purely geographical standpoint. It may, therefore, be affirmed that the detailed survey of the Patagonian territory first became of importance when the agitation commenced with respect to the boundary question between the Argentine Republic and Chile.

Both countries claimed, as a heritage from Spain, the austral region, and if both parties were in possession of documents, more or less authentic, which support their arguments as to the respective jurisdictions prior to the emancipation from the mother country over the territory in dispute, little or nothing had been done by them to determine its nature. The Argentine Republic considered as belonging to her the territories to the east of the crest of the Andean mountain range, or the "Cordillera Nĕvada" of the *conquistadores* and the Spanish historians—a formidable barrier and boundary imposed by nature herself; whilst Chile maintained that her territory included Patagonia as far as the Atlantic coast, and proposed to colonize the territory situated east of the Cordillera, which Captain Simpson, of the Chilian navy, had traversed, in 1873, from side to side, following the course of the Aisen river until he saw it descend from the eastern plains. The Argentine Republic possessed settlements in Rio Negro, Chubut, Santa Cruz, and Staten island; whereas Chile had founded Punta Arenas in the Straits of Magellan, but the interior of the country remained an enigma, which commenced to be solved in 1872, when an Argentine naval officer, Mr. Feilberg, ascended for the second time, forty years after Fitzroy, the river Santa Cruz, and proceeded as far as a lake which he believed to be the one discovered by Viedma, in 1782.

It was in 1873, when I made my first excursion to Patagonia, that I visited the Rio Negro. The year following, I returned to the same places, and went as far as Santa Cruz. In 1875 I crossed from Buenos Aires to Lake Nahuel-Huapi and the Andean Cordillera, between parallels 39° 30′ and 42°. In 1876 I visited Chubut, and ascended the river Santa Cruz, recognizing that the lake found by Feilberg was not the one Viedma discovered, and that these lakes, with many others, formed a vast system situated in a longitudinal depression parallel with the Cordillera. In the tract of land between Santa Cruz and the Straits of Magellan, I was able to confirm the fact already announced by the first Spanish navigators and by the hydrographers of the "Beagle," that the Andean Cordillera was traversed by channels which conveyed the salt waters of the Pacific to the Patagonian plains, and that the chain, shown in many maps as separating Otway Water from the Straits of Magellan,

does not exist, the isthmus consisting of an insignificant deposit of loose stones and sand left by the ice, and scarcely raised above sea-level. In 1877, some Chilian officers visited the sources of the river Santa Cruz in the lake. Steinmann shortly afterwards reached the same point, as well as the Argentine travellers, Castillo, Moyano, and Lista. Moyano crossed from Santa Cruz to the Chubut, partly following the route taken by Musters and that of Durnford, who had visited lakes Musters and Colhue in 1877. In 1879 I again returned to the Rio Negro, crossed Patagonia as far as the Cordillera, on parallel 44, and followed the slopes towards the north, again examining lake Nahuel-Huapi, and reaching nearly up to parallel 39°. If, up to that time, the surveying of



EASTERN SLOPE OF THE CORDILLERA OF THE ANDES AT LAST HOPE INLET.

those regions was not exempt from a certain amount of danger, in view of the attitude of the native tribes, this danger disappeared after the defeat inflicted upon them by the Argentine forces. It was at this period that the 1881 treaty was made, by which Argentina and Chile remained separated in Patagonia, to the north of parallel 52°, by the Andean Cordillera; and expeditions continued to explore the latter. The treaty stated that the boundary between the two countries was the Cordillera of the Andes, and that the dividing line was to run along the watershed of the highest crest. But when boundary treaties are not preceded by an adequate survey of the land on which this boundary is to be traced, they always give rise to difficulties when they are being

actually carried into effect. These difficulties soon arose. Which was the line agreed upon? The Argentines maintained that it was the crest of the Cordillera in its watershed; whereas the Chilians advanced the opinion that the boundary agreed upon was the parting of the continental waters, whether that coincided or not with the crest, or was situated outside, and at a distance from, the Cordillera.

Chile sent out explorers, who penetrated the country from the west; and the Argentine Republic did the same. I myself set to work to carry out similar investigations with the conviction that, in the same way as the logical development of a nation is not achieved unless the geography of its territory be known, nothing can be more prejudicial to its interests than such ignorance in discussions relating to its frontiers. From 1882 to 1895, I examined the Andean regions of the Republic, between parallels 23° and 34°; and, in 1896, I returned to Patagonia by the slopes of the Cordillera and the interior thereof, until I reached Lake Buenos Aires, in 46° 30′. In 1897 I visited the Patagonian region situated between the Straits of Magellan and parallel 51°, and examined several of the western fjords as far as Puerto Montt, in latitude 42°. In 1898 I ascended, for the second time, the Santa Cruz river, reaching the same point visited by me the previous year, on parallel 51°, and, along the eastern slopes, I traversed the territory as far as Lake Nahuel-Huapi and Puerto Montt. It is with this material that I purpose giving a sketch of what Patagonia is, under various aspects; the deficiencies of which sketch will, I think, be made good by the photographs I shall show.

II.

Many of the Patagonian landscapes will certainly be surprising. Captain Fitzroy and Charles Darwin were very unfortunate when they explored the river Santa Cruz. The landscapes left a disagreeable impression on them; and this impression subsequently became general with regard to the whole of Patagonia. In my own country I have found considerable difficulty in obtaining a hearing when I have stated that, although the English explorers spoke the truth, and that any one visiting the same spots would receive the same impression as they did, nevertheless, Patagonia did not merit its bad reputation; but, on the contrary, a vast field for human initiative existed there, with a healthy soil capable of supporting a large population.

In comparing the mountains of South America with those of North America, we might say that the Brazilian mountains have a corresponding situation to the Appalachians; that some of the Peruvian, Bolivian, and Argentine ranges have an analogous position to the Rocky Mountains; whilst the Andean Cordillera corresponds to the ranges on the North Pacific coast. The same vast plains, the same great ridges, and almost the same high plateaus, characterize them. The landscapes

of the Mississippi are reproduced on the Paraná; the broken plains and the plateaus of New Mexico and Arizona find their analogy in the Argentine northern plateaus and in the table-lands of Patagonia; whilst the ice-bound plains of Canada find modest companions in the extreme south; and the picturesque fjords and white mountains of Alaska seem to be a copy of the fjords and mountains of Patagonia, or *vice versâ*. The analogy might be carried still further. It is surprising what a similarity exists between the ancient industries of the natives of New Mexico and those of north-west Argentina; and any one who compares the ancient customs and industries of the coast of the Pacific Ocean—at either extremity—will obtain some curious revelations.

MYLODON CAVE NEAR LAST HOPE INLET.

The territorial area of Argentina consists of more than a million square miles, and, in three-quarters of its extent, presents the contrast of the most level plains in the world, with mountains which may be reckoned amongst the highest. With the exception of the rugged nature of the north-west regions, which are prolongations of the mountains of Bolivia, and a few small islands of the ancient Pampean sea—so well described by our associate, Colonel George Earl Church—one passes from the superficies of the said sea to the abrupt wall of the mountain in so striking a manner that the natives call the slopes, the "Costa," thus, perhaps, evoking the lost sea or the great lakes which filled it, and of which traces still exist, and which indubitably existed in the human period.

This spectacle of the mountain abruptly dominating the plain, stops at the height of parallel 34°, and the vast *pampa* is scarcely interrupted at the south by the archaic and paleozoic rocks of the Tandil, the Ventana and the Pampa Central, bounded on the east by the Atlantic, and on the west by the scarcely discernible continuation of the central-northern ridges which divide the plain of a western depression that commences in Bolivia, in lake Titicaca, or further north, and carries the waters of the Eastern Andean region of Argentina to the Atlantic by the river Colorado. This depression is, in its turn, limited on the south by the plateau which separates it from the Rio Negro, and it is this plateau which is generally considered as the northern limit of Patagonia; although, owing to many of its physiographical features, the Patagonian *facies* may be considered as extending as far as the Bolivian plateaus of the Titicaca, agreeing generally with its flora and fauna.

It is difficult to state briefly what ought to be understood by the expression "Patagonian Region" in its general characteristics; and I must, for the present, confine myself to assign its political limits which, on the north, are the Rio Negro; on the south, the Straits of Magellan; and, on the east and west, the ocean. Within its 300,000 square miles, the landscapes offer striking contrasts. To the east, from the sea, are seen coasts with smooth horizontal surfaces, with slight prominences between parallels 44° and 47°, caused by eruptive formations; a coast which is the cliff of the traditional table-land, streaked with grey, yellow and white bands, of dreary aspect, with perpendicular walls, and a scarcity of ports. On the western side, the scenery is utterly different: a number of islands, with abrupt and wooded coasts, fringe the precipitous coast-line of the continent, which is indented by numerous fjords that penetrate to the very heart of the Cordillera and traverse it completely in the 52° of latitude; a coast similar to that of Norway, or, better still, to that of Alaska, with glaciers reaching down to the sea from parallel 44° 30′, and three-quarters of the mountains covered with ice and snow.

Between the two coasts, terraces cut into the elevated plateau, some extensive, others reduced, form the table-lands, separated by depressions (the most extensive, being transversal), generally covered with a layer of pebbles, and, here and there, by lava-streams, between the remains of the ancient range which has nearly disappeared from the centre, which remains are, perhaps, the continuation of the mountains of Central Northern Argentina, and in the west a longitudinal depression that precedes the Andean Cordillera and lies parallel to it. This depression is of a smooth and gently undulating character, of an exclusively erosive and glacial aspect, but evidently of tectonic origin, very beautiful, dotted with numerous lakes. Some of these lakes empty themselves into the monotonous Atlantic rivers; others reach the Pacific in impetuous torrents which cut through the whole mass of the Cordillera. The

hydrographical network is then so rambling, that it is not always possible to fix the exact course of some of its secondary components, which sometimes flow into the Atlantic rivers, and at other times into those of the Pacific, their course often depending on periods of rain or drought, or the shifting of sand or shingle, and also, sometimes in certain springs, on the action of rodents, which are a veritable calamity in Patagonia, but easy to remedy. This phenomenon of a dividing-line of waters flowing into opposite oceans, which partly rise in plains and glens hardly higher than the level of the sea, and which overcome such formidable obstacles as the Andean Cordillera, piercing its crystalline axis and the

CONTINENTAL DIVIDE IN THE GLACIAL DEPOSITS OF RIVER VISCACHAS.

enormous mass of rocks which have accumulated upon this axis, constitutes, in my opinion, a fact which is unique in the world.

It is very possible that, when a careful survey of the Andean Cordillera and its vicinity is made, it will be proved that a great portion of its actual upheaval took place in very modern epochs; and that man, already possessing a culture analogous, to a certain extent, to that of nations which are reputed civilized, witnessed the modification of the physiognomy of the soil of South America. It seems to me incredible that man could have found means of existence at an altitude of 18,000 feet, and yet, at this elevation, on the Puna de Atacama,

human remains have been found, which proves that he did. The gigantic ruins of the Bolivian table-lands suggest that the upheaval of the soil to its present altitude was subsequent to the construction of the buildings, the ruins of which are preserved, as man could not now construct similar works there. I have seen on the Puna de Atacama, in parallel 26°, at an altitude of 14,000 feet, the remains of extensive villages, where it would not now be possible for moderate groups of people to live. It is well known that there are abundant remains of the great pampean mammalia in the clay formations of the Bolivian plateaus; and it is difficult to believe that such animals could have lived at that altitude.

The extreme south participates in this recent upheaval of the Earth's surface, and its orography is intimately connected with this movement, which is still going on, and which is, with erosion, also probably one of the causes of the abnormal water-divide of the continent leaving the crest of the Cordillera in Patagonia, to transfer itself to the plains lying alone on its eastern slopes. Charles Darwin has left us some observations of the utmost value with respect to the upheaval of the Earth's surface in South America; and it is a matter for regret that they have not been continued with similar attention by subsequent obs· rvers.

If a careful examination be made of the accounts given by the early navigators who visited the extreme south of America, we shall find that the country, as they saw it, has been modified in several places. It is very possible that some remains of the channel shown in some of the maps, between Admiralty sound and San Sebastian bay, in Tierra del Fuego, existed at that period; that the isthmus which separates Otway Water from Magellan straits, did not then rise above high-water mark; and that several of the streams now flowing into the Pacific from the east of the Cordillera, and even from the Patagonian plains, crossed them to reach the Atlantic:—a mass of facts which ought to attract militant investigators, all the more that the places in which they are to be observed are, more or less, easy of access, compared with other places in the world, of less interest, but which, nevertheless, are much better known.

In the reports of Dr. Otto Nordenskjöld, the Society possesses a general exact picture of the physiognomy of the large island of Tierra del Fuego. This island I have only seen from the sea; and Sir Martin Conway has graphically described the mountainous western portion. My description will commence, then, in the Straits of Magellan. When the coast is observed from the Atlantic, one sees the straight line of the terraces on both sides, and the others of Virgin Cape. Once in the straits to the north, on the low base formed by the coast, the tertiary line stands out, now receding, now advancing; its regular summits broken by small hills, which are so many extinct volcanoes. At the foot of the

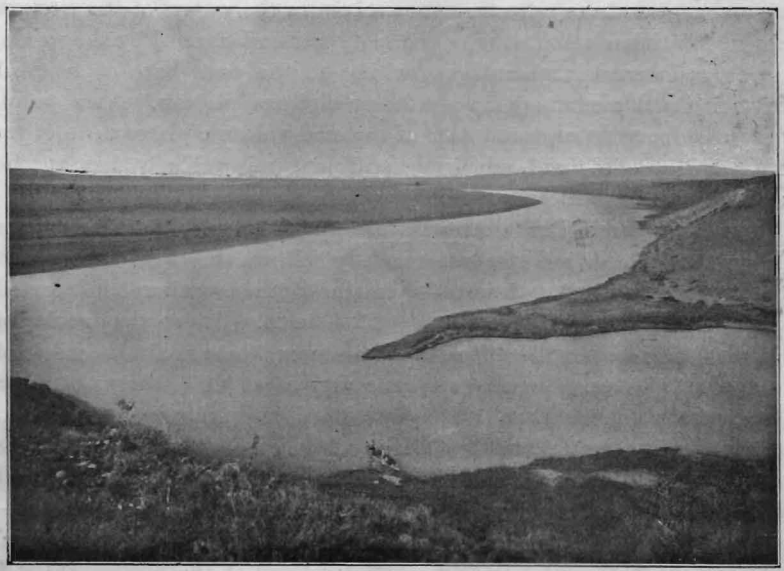
and we might assert, even, that their strata are of the same age, as is proved by the fossils which have been found in them. The recent volcanic eruptions extend from parallel 41° up to the straits in the same zone; and the periods of eruption seem to have been almost identical; the Mount Aymond volcanoes are similar to those of Mount Yagagtu in Rio Negro territory. The uniformity is almost general: the same geology, the same fauna, and the same flora; and it only alters in the north with the remains of the longitudinal ridges which appear to the south of Rio Negro with its granites, porphyries, trachytes, and ancient schists, extending, in more or less imposing masses, as far as the river of port Desire, dividing Patagonia and its table-lands into two parts, north of this parallel. I am of opinion that, in the early days of the tertiary formation, Patagonia was of greater extent than at present; that a part of its territory advanced much further into the Atlantic; and that the bed of the latter, between the present coast-line and the eastern parts of the Falkland islands, was nothing else than a plateau, submerged at a relatively modern epoch, the upheaval of which has again commenced.

The bold, characteristic relief of the Patagonian terraces is intimately connected with the upheavals, and erosions produced by great rivers and lakes, the greater part of which have since disappeared. These terraces are really true lines of level left by these rivers and lakes, which did not all, however, have their origin in the present Cordillera; but some had their origin in the centre of the country, which to-day is almost entirely waterless, and which, it also appears to me, were connected with lands which have now disappeared.

The larger number of the lakes which fed these rivers in the Andean region still exists; but of those of the central region scarcely any remain; the twin lakes Musters and Colhue are rapidly drying up, together with a few insignificant lagoons. Nevertheless, when the territory is crossed, one sees great cavities—empty lakes—and vestiges of their powerful outflows. Their shores present characteristic terraced levels; and in connecting their lines of elevation, one finds that, as I have remarked, the terracing is not generally regular. The present terraces are nothing but the evidences which have been left by ancient lacustrine or fluvial levels; and although the altitude above the sea of the strata of which the general table-land is composed is greater on the west—thus exposing to view others on the western border of the plateau which do not appear in the Atlantic coast—this fact is not of a perfectly absolute uniformity, as, in San Julian on the sea-coast, cretaceous strata are observed, as also in the vicinity of the Cordillera.

The monotonous plateaus generally terminate, as I have stated, in the vicinity of the first mountains, which are parallel with the true Cordillera, and the general character of the Patagonian region completely changes. If you examine the map of South America, you will

see that, to the south, two chains of mountains exist: the Cordillera of the Andes, and the Cordillera of the coast in Chile. It may be said that, from the Atacama desert, the two chains run parallel to each other; at times their spurs seem to become confounded; but the geologists Pissis and Domeiko have pointed out an intermediary valley running between them, throughout their extension, from north to south. In the north, this valley is filled principally by the products of recent volcanoes; it is then contracted, and almost obliterated, by the spurs referred to; but it subsequently widens out to form the very fertile central valley of Chile, gradually descending to the south until it buries itself beneath the Pacific, opening out or contracting itself, as in the



RIVER SANTA CRUZ.

north, and covered with alluvial deposits and ashes even under the coast waters of the Pacific, as far as Tierra del Fuego; a tectonic valley, and perhaps one of the longest in the world. Parallel to this, but situated to the east of the Cordillera, a similar valley is found, the existence of which was suggested by me in 1879, which is more or less continuously contracted or effaced by the same causes, but not completely buried under water, as has happened to the western valley. The Andean Cordillera rises between the two depressions. The Chilian valley penetrates the sea at parallel 42°; but three degrees above, the chief part of its extension, it is occupied by a series of lakes, generally transversal, which seem to fill cavities that coincide with profound ravines in the Cordillera, whereas the Argentine valley only

sinks beneath the sea 10° further south. In this eastern longitudinal valley, the actual lacustrine series fills the space comprised between parallels 38° and 52°, at times interrupted by local tectonic accidents, which took place after its period of formation, or by vulcanism or accumulations of glacial detritus. This general valley forms one of the most interesting, most fertile, and most beautiful zones of South America, owing to the variety of its topographical forms, the geological construction of the enclosing mountains—which breaks the monotonous grey of the Alpine views—the flora with which it is adorned, and the immense glaciers, some of which send crystalline icebergs into the green or blue waters of the lakes. Another Patagonian contrast is the white and blue ice on the black basalts, crenellated peaks, and cliffs of monumental shape reflecting themselves in the waters of the western shores of the lakes, mingled with the leafy garlands formed by the woods, so rich and varied in their flora; whilst to the east, bare of arboreal vegetation and monotonous, rises the precipitous plateau. At a jump, one passes from the elevated flats of the arid volcanic plateaus to green fields and wooded valleys; from stiff and miserable bushes to the handsome fern and fuchsia region.

Setting out from Punta Arenas, towards the north, the woods cover the cretaceous hills, and the road mainly follows the high-water mark, winding between rocks, the erratic remains of the now almost obliterated moraines, and partly traverses beautiful fields. Under the trunks of old trees one meets with deposits of molluscs, the remains of meals of the ancient natives. In this way one arrives at the isthmus between Otway water and the straits; the ground undulates, the woods disappear, and, gradually, erratic boulders become visible everywhere, looking like small isolated hillocks between the cretaceous hills and the distant cliffs of the Saint Gregory plateau and the straits, where salt lakes—vestiges of the very modern upheaval of the region—are to be seen. Immediately to the west is Otway Water; and at the bottom the low hills of King William's land, which precede the "Cordillera Nevada."

The Andine eastern longitudinal depression is partly represented there by the Fitzroy channel, and its vicinity is dominated by the edge of the western tertiary plateau, which rises gradually, cut out on the western shores and ravines by rain and frost; and, to the east, the volcanoes Orejas de Burro, Mount Aymond, and La Picana, from 700 to 1000 feet altitude. I have already remarked that the plateau commands the straits from Virgin cape. Between this and the valley of the river Gallegos, the undulating surface is grassy, sparse in timber, with deep gorges which cross each other, and with volcanic cones which have scattered lava-streams in ancient and recent times. Hundreds of thousands of sheep now pasture upon it, whilst in the deep gorges of the Atlantic coast, gold-seekers continue their researches in the glacial deposits. The Argentine-Chilian frontier line crosses it from

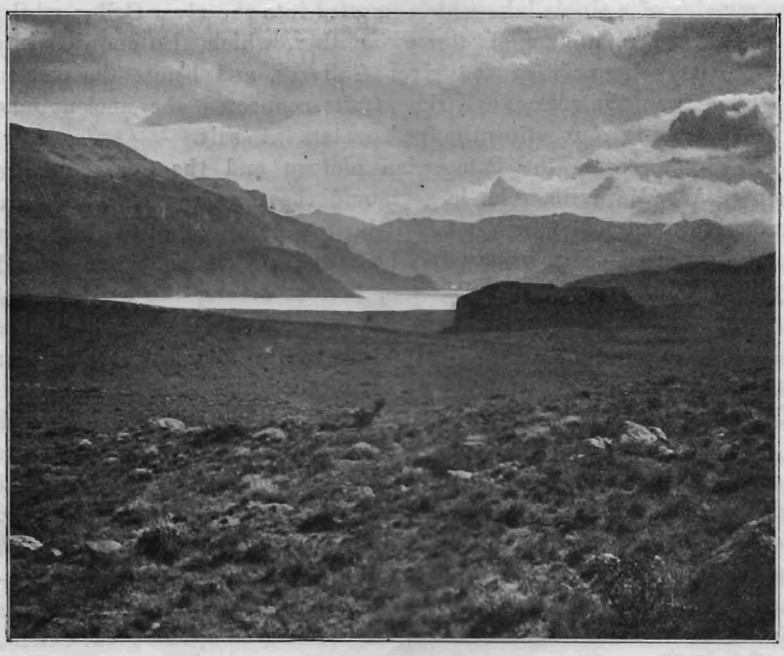
moraines and frontings cut by the great glacial river, the gradual decline of which is shown by the terraces left by its distinct levels.

When the Spanish navigator, Ladrillero, in 1557, entered the channels to the west of the Cordillera, in search of a passage to the Atlantic, he found low-lying lands, and in them a channel more than 45 miles long by 4½ wide, penetrating east-north-east. In 1830 Lieutenant Skyring and Mate Kirke, of the *Beagle*, explored the same regions, and observed a vast expanse of water divided by a low isthmus cut by a river which drained it, the remains of the Ladrillero channel. I say "remains," as I think that the elevation of this isthmus is of very recent date, as indicated by the young trees referred to by Kirke. This sheet of water is now known by the name of Lake Balmaceda; and to the south of this another one of the same size, Lake Pinto, is found, whilst to the east there are other smaller ones, situated between various lines of moraines, more or less destroyed, which separate the waters that, from the northern and southern plateau, flow westward to feed these waters, and, eastward, to form the river Gallegos. This is a characteristic glacial landscape; the boulder clay, which is seen very distinctly in the Blanca lagoon, fills the valley, being displayed in large patches in the same way as is observed in all the other northern valleys. The remains of dividing moraines does not attain in some parts an altitude of 200 feet above sea-level, and abounds in large erratic, perfectly striated rocks.

This river and its affluents flow in a capricious and winding manner, leaving on either side the marshy remains of the ancient fresh-water channel. Imagine the British Channel dry, covered with boulder clay deposits, and a river wandering in its centre to the east, receiving streams from the cliffs of the two coasts, while little hillocks, like those in some parts of London, separate the western streams from little lakes overflowing in that direction to the Atlantic, and you will have the impression of every one of the transverse depressions of Patagonia, the western Atlantic being replaced there by the Pacific channels or the Andean lakes. Lake Balmaceda measures, approximately, 40 square miles, and is partly fed by the waters of other smaller lakes and by streams. Between the most eastern of these lakes and a group of smaller ones which send their waters to the river Gallegos, there is a glacial deposit barely 60 feet wide. In times of flood, these small lakes communicate with each other, and for the time confound the waters flowing to the Pacific with those which go to the Atlantic. It also seems that one of the affluent rivulets of Lake Balmaceda is thrown off from the river Rubens, an affluent of the Gallegos. This river and its affluents have a winding channel, leaving lagoons on either side, the remains of the ancient channel now replaced by the valley.

The present transverse valley takes part in the longitudinal depression

now occupied by the waters of the Pacific, and is bounded on the south by the plateau extending between the Gallegos river and Magellan strait, and on the north by what has been called the Latorre Cordillera, which is not a mountain range, but the continuation of the general table-land itself. Between this and the channels, rise, south of the parallel 52°, the cretaceous ridges, Rotunda and Palladium hills, and to the west, the mountains in front of the principal chain of the Cordillera, here formed by the Sarmiento Cordillera. In Last Hope inlet, which forms a part of these channels, the eastern longitudinal



ANCIENT EASTERN OUTLET OF THE LAKE SAN MARTIN.

valley depression, to which I have referred, terminates under the sea-water.

Dr. Otto Nordenskjöld has given the Society a general description of the part of this depression comprised between the Sierra de los Baguales and the Last Hope inlet, and I will only dwell on this in order to amplify these *data* with a few new observations which complete them. If one penetrates to the extreme west of the Last Hope inlet, this is seen to open out into three branches; the centre one gives entrance to a small lake situated in an opening, which it seems had previously communicated with the Canal de las Montañas, in the extreme north of which flows a river draining another lake, likewise situated in the same depression. The Canal de las Montañas constitutes

the extreme end of a longitudinal valley which separates there the central chain of the Andean Cordillera from the more fragmentary lateral ridges, and to which Mount Balmaceda belongs, and at the eastern base of which the river Serrano empties, bringing to the inlet the waters of the eastern general depression from Mount Stokes glacier, which feeds Lake Dickson. The same river also receives the waters of the central chain, at the base of which is Lake Tyndall, which is bounded on the west by a sheet of ice, truly *Inlandeis*, the remains of that which, in other times, covered the region as far as the present Atlantic coast. All the lakes of the region, even the eastern lagoons, are remains of a single lake which emptied into the river Coile; whilst the present Pacific channels formed another, which also emptied into the Atlantic by way of the river Gallegos, and before the erosion wearing away the rocks in Kirke straits connected the ancient lake with the Pacific, converting the fresh waters into salt.

To-day, between the Patagonian plateau and the Cordillera are found lakes Maravilla (the largest, and the moraines of which are perfectly preserved), Sarmiento (without visible outlet—which must be subterranean—also surrounded by moraines), Paine, Hauthal and Tyndall, Nordenskjöld and Dickson, besides others, the existence of which is known, but which have not been closely inspected. These lakes, formed in tectonic fractures and continued in depressions cut out by the ice, are separated from each other by isolated mountains, of more or less altitude, some having extensive glaciers, as in the case of the interesting Mount Paine, a beautiful massive tertiary granitic laccolithe capped with cretaceous slates, connected by a transversal ridge with the main chain of the Cordillera, and not a volcano as Dr. Nordenskjöld thought; others formed of the same slates, of less height, and with rounder peaks, presenting the form of a whale-back—the name one of them bears—all being mountains which formed the islands of the great exhausted lake, the bed of which, to a great extent, has disappeared, either through the upheaval of the soil or through the glacial detritus which covers all the shores. The landscape is extremely picturesque in this region. To the west, the high mountains of the granitic central chain, with its ice-field and its *nunatacks;* lower down, wooded valleys and the mountain-lakes between the fjords studded with icebergs detached from the ice-fields. Then come the wooded mountains, some with glaciers, of the lateral ridge, formed by metamorphic schists, probably of the lower cretaceous, cut by the deep lakes and by the rivers which drain them. Next we have glacial lakes, occupying the old mouth of the lost fjords, and surrounded with moraines on the east; and, on the north and south, cretaceous mountains covered with woods, and hills polished by the lost glacier of the first extension of the glacial period. Then follow the tops of the little transition hills, of the upper cretaceous, which precede the tertiary table-land, and which it may be said limits

the longitudinal depression. The western slates, greatly contorted, assume fantastic forms with their folds, through the deposits of snow between the layers, and rise perpendicularly above the fjords. In one of these intermediary hills, near Last Hope inlet, is situated the cave where the piece of *mylodon* skin was found which has so much attracted the attention of English naturalists. The explanation of the presence there of this extremely interesting piece is difficult; at a time when the animal died, probably the cave was not situated at the same altitude as it is to-day, and the proof of this is the perforation of the rock by pholades. The discovery made by the geologist, Mr. Hauthal, one of my travelling companions, of a bank of *Mytilus edulis*, situated about 7 feet above sea-level, is an evident proof that the upheaval continues.

As I have already said, the transition is violent between the Cordillera and the Patagonian plain; it is most notable in this part of the depression. To the west from the high raised cliff, called Sierra Dorotea, and inclined in the same direction, the tertiary sandstone appears, which extends from the Straits of Magellan, always cut by the transversal depressions, which, further north, surround the base of the Sierras Baguales and Viscachas. This sandstone, in its turn, is covered by the neo-volcanic tuffs, and the glacial gravel deposits which form the so-called Latorre Cordillera, and which, as I have said, is only the characteristic Patagonian plateau, gradually rising from the Atlantic towards the Cordillera, to which, perhaps, at one time, it was united. I have visited the depression and the plateau, and in my excursions I have crossed all the transversal depressions, and have always found the same physiographical character. The tertiary sediments rise gradually from the Atlantic towards the Cordillera; in the vicinity of the latter cretaceous formations appear with tertiary eruptive rocks, the upper ones under the tertiary, the lower exposed at the surface in the centre of the depression, bordering the chains of the Cordillera composed of gneiss, granite, and quartzite, and some sandstones of undetermined age. On the table-land there are more or less extensive patches of volcanic eruptions with their tuffs; the part played by these eruptions in the upheaval of the soil it is not yet possible to determine conclusively, but they have taken place during the whole of the tertiary period up to recent times.

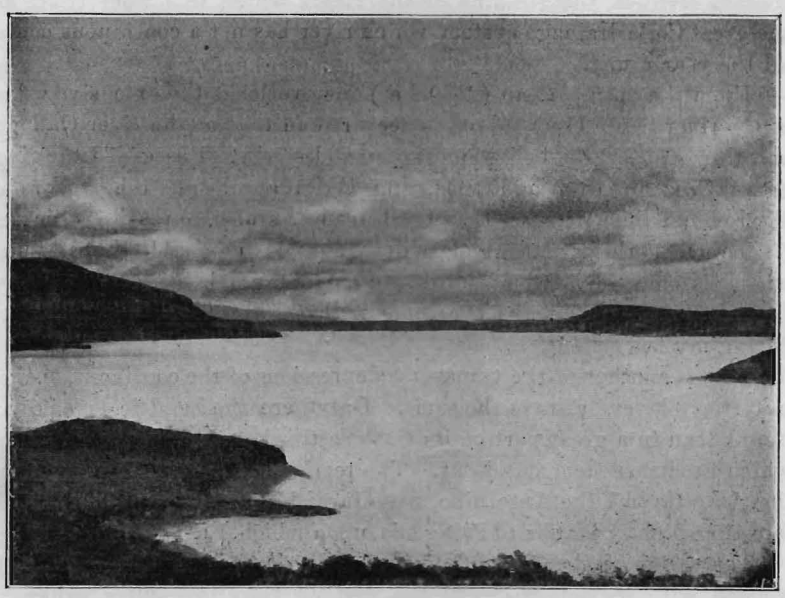
Between the Sierra Dorotea and Punta Alta rises the principal affluent of the Gallegos river, which waters the whole valley, and is occupied by important *estancias*, as is also the case in the neighbourhood of Lakes Maravilla, Sarmiento, and Paine. I have crossed the Patagonian plateau in the vicinity of the Atlantic, and also between Punta Arenas and the Sierra de los Baguales, and, *de visu*, I can state that, although, looking at the cliff from Obstruction sound, it may be considered as a mountain ridge, it has not the slightest analogy with the general idea of a mountain. Its surface, generally flat, with small

undulations produced by glacial erosion, more numerous on the west, covered with gravel, and displaying erratic boulders of great size, extends towards the east, losing itself in the horizon, abounding with guanacos and ostriches, poor in trees and pastures, forming another ancient island between the transversal depressions of the Gallegos and Coile rivers, which also carried to the Atlantic, in other days, the waters of that part of the Cordillera in their broad channel. To-day the enormous accumulation of glacial detritus has modified the hydrographic regimen. At the extremity of the north-west cliff of the plateau rises the principal arm of the river Coile and also the Guillermo rivulet, which flows westward to empty in Lake Maravilla, forming, in this way, another instance of the water-parting of the continent in the plain, on the east of the Cordillera. The landscape is essentially glacial; the various semicircles of the moraines and the winding ridges are seen with perfect clearness, and have accumulated such a quantity of remains, that it must be admitted that the glaciers which produced these accidents had no great oscillations before retiring to where they are now seen in the Cordillera. Large erratic boulders abound as far as 50 miles east of the present snowy mountains; and on the shore of the Coile, near the so-called Mount Palique, a tertiary hillock, covered by the remains of a moraine, I have seen some granitic rocks measuring as much as 400 cubic yards. This so-called Palique mountain is washed on the east by the Viscachas rivulet, one of the most interesting streams of the region, and similar in its characteristics to the river Fenix, to which I shall refer.

The transversal shores of the Sarmiento-Coile's ancient channel is bounded on the north by the Baguales mountains and Viscachas plateau. These mountains were formed by a general upheaval, greater to the west of the plateau, their relief having been increased by modern eruptions, and on the west by cretaceous rocks, among which Hauthal saw layers of diorite, which have accentuated by their upheaval the relief of the mountains. They appear to be separated from the Cordillera by the continuation of the longitudinal depression, which is contracted in that part, and filled with ice from the mass to which Mount Stokes belongs. This glacier separates the basins of the southern lakes from that of Lake Argentine, which feeds the river Santa Cruz, thus sending waters to the Atlantic and waters to the Pacific, by the eastern side of the Cordillera. These waters flow southward to Lake Maravilla by three main streams — the rivers Zamora, Baguales, and Viscachas. The latter, which is the most eastern, and rises in the basaltic plateau, has a course particularly worthy of notice: first it flows to the south-east; then it inclines further east, to again twist violently to the west to the foot of the Palique hill. I have examined these points, and found there one of the most interesting cases of river-capture of Patagonia. In March, 1898, a ledge of shingle and sand, scarcely

3 feet in height, divided the river Viscachas from other channels, then dry, which in the rainy season flowed to the Atlantic; and the natives of the place assured me that at certain periods, when it was in flood after the melting of the snows, the waters flow indiscriminately towards both sides. To-day the waters are diminishing on the east of Patagonia; for some years past rains have been less frequent, and this diminution explains certain phenomena produced there in their distribution.

The Gallegos-Coile plateau turns to the east, diminishing in elevation, eroded by glacial action into cavities, having fresh and salt water ponds or pools, the remaining vestiges left by the Atlantic at the time of the last upheavel of the table-land, until it contracts to the transverse



ANCIENT EASTERN OUTLET OF LAKE BELGRANO.

valley through which the principal affluent of the Coile river runs. If this is crossed and traversed to the north, ascending and descending the undulations covered with glacial mud and with great erratic blocks, and a grassy country which will soon pasture thousands of sheep, one penetrates into the broken ground of the east of Sierra Viscachas between lava-streams of the most picturesque aspect. This is one of the points of Patagonia where the layer of glacial gravel which covers it is most visible. It is seen that, in certain places, the horizontal character of its layers has undergone modifications, and I have examined places in which the gravel layers may be said to be almost vertical, which is only explicable by very recent subsidence or faults. I crossed the plateau from the middle of the Santa Cruz valley to the west, and took the opportunity

to examine its terraces and the isolated depressions of ancient levels, and I think I am safe in asserting, supported by observations made at other points, that some of the depressions of the plateau, and therefore some of the elevations of its borders, are caused by local subsidences, such as occurred in the Yagnagoo plain in the territory of Rio Negro. The St. Joseph bay and New Bay, on the east coast, must have the same origin. Some low hills which are seen on the plateau are entirely composed of beds of stratified rounded gravel, and appear to be the remains of a general layer which has now almost disappeared.

As always happens in Patagonia, the region is more broken to the west than to the east of the plateau; deep gorges, more or less wide, contain rivulets, the remains of the rivers which in former times fed the great Coile drainage system, which river has not a continuous course all the year round.

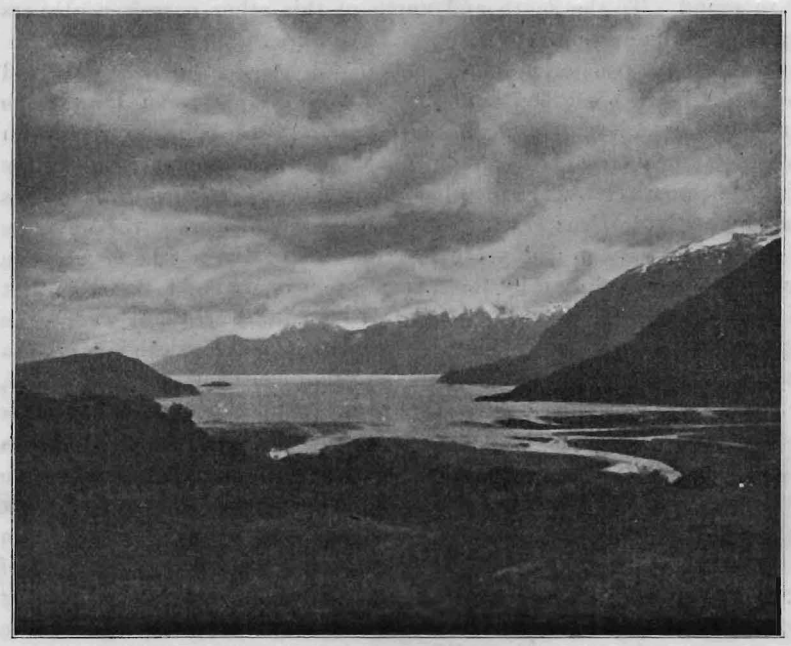
From the open plateau (2500 feet) one overlooks the extensive valley of the river Santa Cruz, which is deeper than that of the river Gallegos and that of the Coile, being more stony and sterile. I ascended the river Santa Cruz in 1877 and 1898, and I can appreciate the labours of Fitzroy and Darwin when they tried unsuccessfully, to reach its sources. Undoubtedly the great river will be easily navigable by steamers when its channel is once known, its current not being extraordinary, seeing that it was always overcome with a small 9-knot steam-launch during my last ascent.

This is another of the transverse depressions of the continent, opened in tertiary layers, always the same. Only here the basaltic lavas cover the plateau in a great part of its western third, and upon it the craters which produced them stand out. The tertiary cliffs of this valley, from the Atlantic to Lake Argentino, have furnished the remains of very interesting fauna peculiar to Patagonia, upon which I cannot now enlarge.

The valley of the Santa Cruz has also been occupied by ice, and is covered with its detritus. To the east of Lake Argentino, where it rises, one sees on the cliff which overlooks the present river, 150 feet above it, erratic boulders of 600 cubic yards, which have been left by the glacier that formerly covered the lake, the moraines of which limit it.

Lake Argentino is more extensive than Lake Maravilla, partaking of the tectonic and glacial lakes. It extends 60 miles to the west; and the fjords of its extreme west divide into three arms, which receive the waters of large glaciers from Mount Stokes up to the vicinity of Lake Viedma. An important river flows into the end of the north fjord, with clear waters—a sure sign that it proceeds from another great lake still unknown. The western end is closed by the main chain of the Cordillera with its glaciers, which cross to the Pacific fjords of Peel inlet and St. Andrew's sound, and one can distinguish peaks more than 10,000 feet, as Mount Agassiz (10,597 feet). The lacustrine fjords correspond to the western channels, and communicate with

those of the south by the glacier of Mount Stokes by Lake Dickson. Undoubtedly Lake Argentino was more extensive formerly. Mount Buenos Aires and Mount Frias were, in very recent times, islands in the southern part of the lake. To-day the waters are rapidly retiring; a large expanse of the southern shore, which was under water when I saw it in 1877, was dry in 1898. The lands left by the retiring waters are very fertile, and the last time I visited the spot several thousand head of cattle were grazing, having been brought there by two English cattle-raisers. This is the first herd that has been raised in such distant regions.



MOUTH OF THE RIVER LAS HERAS, IN THE CALEN INLET.

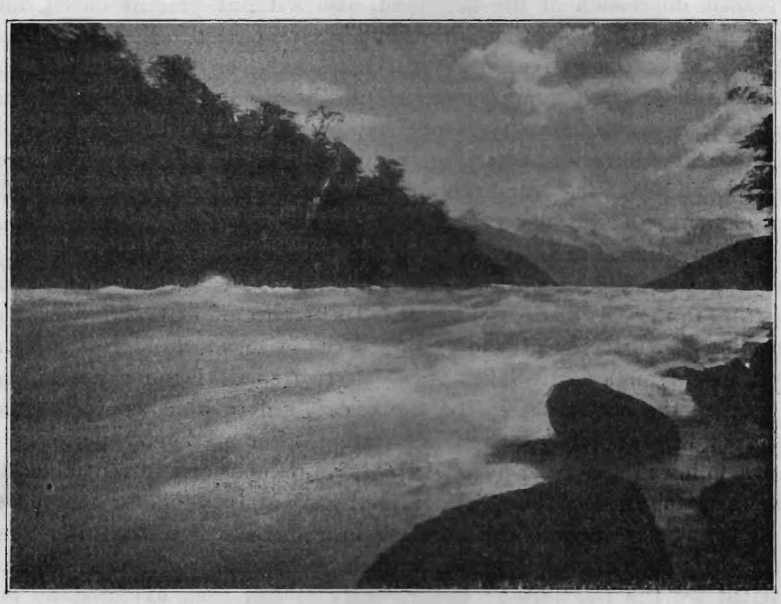
The river Leona drains into the eastern extremity of Lake Argentino, to which it carries the waters of Lake Viedma. This river has a stronger current than the Santa Cruz, between upper cretaceous cliffs, crowned by fossiliferous tertiary caps, which are also observable at the south of the former lake, in which abundant saurian remains have been found. The cretaceous marine formation is observed to the west, at the base of Hobler Hill and Castle Hill, mountains named by Fitzroy, who saw them in the distance. I ascended Leona river in the same steam-launch which had been up the Santa Cruz, and I believe that this river would be easily navigable when once it had been surveyed. The cliffs, completely denuded in the vicinity of Lake Viedma, are composed of clays, sands,

and volcanic tuffs, contain numerous tertiary mammal remains, which await the collector. The gravel cap which covers them did not seem to me so thick as it is further south, and perhaps may have been swept away more easily, as the ravines are at first more frequently produced, perhaps, by neighbouring volcanic eruptions.

Lake Viedma (828 feet) is larger than Lake Argentino, and of a more regular shape in the points examined by my assistants, although it would not be surprising if it had fjords similar to the latter. A vast glacier reaches to the water, and, in clear weather, I have seen it descending from the west like an immense ice-field, from the crest of the central chain, 10,000 feet high, which the ice covers up to its western slope in Eyre sound. To the south and north of this other narrower glaciers are seen in the extremity of the fjord-like bays.

This lake also occupies a tectonic depression, which stretched to the Atlantic, and has had a much greater extension than Lake Argentino, which it still exceeds in extent. At its eastern extremity an extensive ancient arm is seen, which continues up to the narrower valley of the Shehuen river, which empties into the Chico river before it reaches the bay of Santa Cruz. Various dry streams, which were the affluents of this river, were probably the last remains of the northern drainage before it was all effected by the Leona river—a similar instance to that of the river Coile. When I visited this lake in 1877, there were some lagoons which were dry in 1898. The plateau between the river Santa Cruz and the Coile is more broken than that south of the former, and, following the north of the river, one climbs up this plateau, which is covered with basalt, underneath which appear cretaceous sandstones with horizontal folds — a continuation of those of the south. One then descends by depressions through which runs the present river Shehuen, that rises at the base of the same western plateau, the pedestal of the Pana volcano. Again climbing an isolated portion of the plateau, one descends into the true valley of the Shehuen, another depression corresponding to Lake San Martin, which is nothing but the fjord of a large ancient lake. When, in 1877, I followed this valley to descend to the lake, the stream, dry to-day, was partly filled with water. When it has any water now, through snow melting on the lateral plateaus, it runs eastward a little way; but it now seems that it does not reach the river Shehuen, the greater part going westward to the Tar lagoon, which empties into Lake San Martin—another phenomenon of capture, perhaps more interesting than that of the Viscachas, which changes the water-parting of a continent. The Tar lagoon is a remnant of the ancient extension of Lake San Martin, which goes on disappearing, and is found in a plain between the moraines left by the old glacier. Judging by Viedma's account, at the close of the last century a drainage-basin existed to the east, as the natives stated that the Shehuen (or Chalia) river proceeded from a lake. The Kochait mountain—a porphyry boss,

the layers which covered it having completely disappeared—gives a picturesque aspect to the scene, which is varied to the west, monotonous to the east. Through beautiful fields, the bed of ancient lagoons, like Tar, dry to-day, surrounded by moraines, and then through a succession of lines of these,—one arrives at Lake San Martin, the eastern part of which is much smaller than that of Lakes Viedma and Argentino, but the fjords thereof seem to be longer. On the south and east it is enclosed by glaciers between high mountains, but on the north it was impossible to reach its end, owing to the storms which overtook us during the expedition, which also prevented our examining another arm situated on the east of the principal longitudinal depression. It drains into the



RAPID IN THE RIVER LAS HERAS.

Pacific by a river flowing from the end of the ~~southern~~ northern arm. This river is 150 yards wide, and, after crossing a little lake and forming small waterfalls, runs in a northern direction to Calen inlet, thus forming the river Toro, which flows into the south-eastern arm of the inlet. The great river which the Argentine boat *Golondrina* examined in 1897, and which empties in Eyre sound, descending by a longitudinal depression between the mountains of the central chain, seems to come from a yet unsurveyed lake.

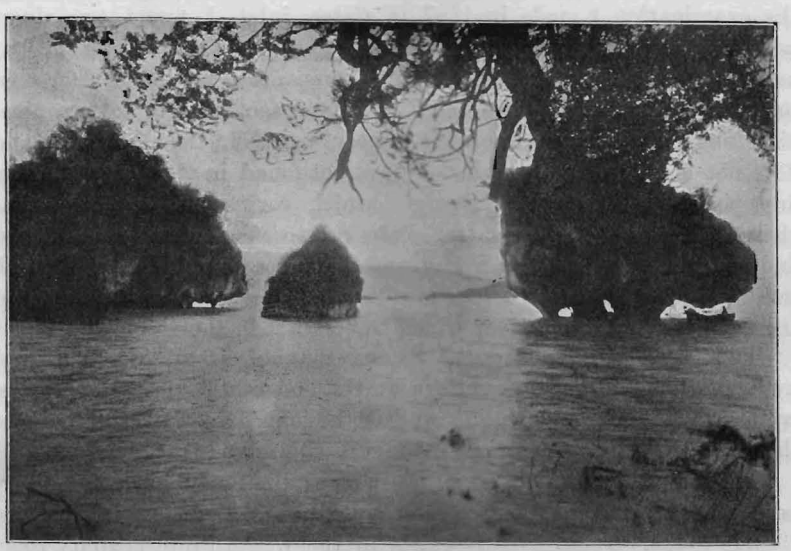
The lake is very picturesque. Its slopes, polished by the ice, partly covered with *Fagus* and *Drimys* woods, and quantities of *Libocedrus* of considerable size are seen, and can be profitably exploited when these regions are inhabited, which will be soon, in view of

the interest of the Argentine Government in it. Its altitude above the sea is 690 feet, and soundings of 1000 feet have not reached the bottom. When I made my last journey, I followed towards the north, climbing the plateau covered with basaltic lava, and in which craters are very frequent. To the west the lava-streams hide the cretaceous caps, but characteristic fossils are found in its slopes. The centre is a vast lava-field, relatively flat, traversed by streams which generally issue from small lakes, and which empty to the south into an extensive lake enclosed by lava-streams, without any known outlet, called Lake Cardiel, but the ancient channel of which to Rio Chico still exists. Another stream empties to the north into Lake Quiroga, which occupies another volcanic depression of the tableland, also without present outlet, and north of that lake another larger one has its outlet to the river Chico. According to the natives, great salt lakes exist on this plateau. The Andine longitudinal depression continues always to the west, formed here, in part, by the eastern fjord of Lake San Martin. The neovolcanic lava-streams have formed a ridge between the river Fosiles, which flows into Lake San Martin, and the river Carbon, which flows northwards as an affluent of the Mayer river. The cretaceous rock is denuded in the steep gorges; and more or less important coal-seams are seen in them.

The river Mayer constitutes another instance of the continental water-parting to the east of the Cordillera. Its eastern affluents and the waters forming the river Chico of Santa Cruz, rise in a depression, the remains of an ancient lake, of which two small lagoons are left as vestiges; the outlet thereof on the east is still visible, as are also the distinct levels left by its retiring waters, after stationary periods. I have followed the river until I saw it, voluminous and torrential, enter the first mountain of the Cordillera, but it was impossible for me to see whether it empties into the northern arm of Lake San Martin or runs straight to the west of the central chain towards some of the fjords, visited by the *Golondrina;* but recently it has been explored by my assistants, who discovered that the river empties into the lake San Martin.

The upper basin of the river Mayer is found at a much greater altitude than that of the lakes already named; the interior longitudinal Andine depression must be found more to the west, so that the plateau between the San Martin and it corresponds to a similar topographical type to the Baguales and Vischacas Sierras. The river Chico rises in the plateau near Lake Quiroga, between the lava-streams, at 4070 feet, and bends eastward when it has once reached by a deep ravine an ancient lake, now dry, where, in the same plain, it increases its waters and sends others to the west by an affluent of the river Mayer. The bed of this lake is situated at 1640 feet, and occupied by two small lagoons, the former communication of which towards the east is perfectly distinct. A little more to the north of the point at which the waters of this basin unite with those from the small glaciers of the

adjacent mountains, to form the river Mayer, discovered by Mr. Hatcher in 1897, there falls into it a torrent from the north (1300 feet) which brings it the waters of a series of lakes situated between a ridge which dominates on the west the basin referred to, and which continues to the north up to Lake Belgrano, cut by Lake Burmeister (2740 feet); this lake, in its turn, drains through the Robles stream into the river Belgrano, affluent of the river Chico. The ridge corresponds to that which extends from Lake San Martin between Fosiles river and the eastern fjord of the same lake. Perhaps the depression where Lakes Nansen and Azara are found corresponds with that fjord. These lakes receive the waters of the beautiful Belgrano lake, which, in its



MARBLE ISLANDS AT THE LAKE BUENOS AIRES.

turn, receives those of Lake Volcan, which is close to it. Lake Belgrano, situated at the base of the eastern ridge, emptied, in modern times, to the east, towards the Atlantic, and had a greater extension than is observed in the series of magnificent terraces which are seen in this direction overlooking the river Belgrano, which winds in the valley, to unite with the river Chico. The Tehuelches Indians, when Viedma made his voyage to the lake that bears his name, told him that the Rio Chico flowed from a lake in the Cordillera. Was this lake the Belgrano, or the smaller Lake Bermeister (2740 feet)? I cannot say now. The wide valley of the Rio Chico, the immense quantity of glacial detritus it contains, and the presence of great erratic boulders, weighing some dozens of tons, which I have seen at its mouth in the bay of Santa Cruz, demonstrate, without leaving any room for doubt, the existence

of a great lake in the latter part of the glacial period, of which the present Lakes Volcan, Belgrano, Nansen, and Azara formed a part, which said lake diminished as soon as communication to the south was opened with the present river Mayer. Lake Volcan is situated at 2560 feet, the Belgrano 2495 feet, and the Azara 2395 feet. The latter enters, on the west, a mountain with glaciers, and drains through a violent stream into Lake Nansen (2296 feet), the western arm of which turns more to the west than the others to the main chain, from the glaciers of which it obtains its waters. Here one observes that the mountains diminish in height towards the south, and are probably cut lower down by the waters of the river Mayer, to which the waters of Lake Nansen arrive through a series of rapids. During the examination I made in 1897 in Calen inlet, I found two rivers which drained into the eastern extremities of its two channels, but neither of them had a flow of waters comparable to what I had seen in the river Mayer. Besides, the Rio Coligue, according to a companion, Mr. Lange, who partly ascended it, appears to rise in the mountains, and does not cross the main chain. I have not found in this river Coligue, any pebbles of neovolcanic origin which correspond to the formations on the east of the central chain composed of granite, porphyry, and quartzite; nevertheless, I saw some huemules (*Cervus chilensis*), which indicates the existence of a pass low down between the east and west of the Cordillera, or else a river which traverses it in the vicinity.

The Indians inhabiting the Pacific channels south of Calen inlet hunt the huemul in some valleys at the end of the numerous fjords, which is a proof that low gaps were to be found in the main chain of that part of the Cordillera, or that rivers intersected it.

The huemul is only found to the west of the Cordillera when river-beds or low passes exist, and it is an error to consider it as peculiar to the Chilian fauna. It principally exists in the western intermediary zone, between the table-land and the first rocky hills, it having even been found in the hills in the vicinity of Port Desire on the Atlantic coast.

If one follows the course of the river Belgrano towards the north, one leaves to the east the Patagonian plateau with its raised borders covered with basaltic lavas, and which attains its greatest height in the Mount Belgrano (6560 feet). Short streams rise at the foot of this eminence, and lose themselves in the lagoons between the lavas or in the centre of the country, such as the Olnie, which becomes extinct in an ancient lake-depression some distance to the west of the main road used by the natives in the very lowest part, where a temporary lagoon still exists. The small gap which separates the waters of the Belgrano on the west from the edge of the raised plateau measures 4920 feet, and, crossing to the other side, there is another stream descending rapidly towards the north to a lacustrine depression, which, starting in a north-north-west direction, then twists to the west. This depression is the deepest that

can be found in Patagonia north of the Lake Maravilla, and is principally occupied by Lake Pueyrredon. The eastern part of the plateau north of Mount Belgrano rapidly decreases in height, and the continental water-parting is situated a good distance to the east. The saline lake, nearly dry to-day, which exists there has an altitude of only 345 feet above sea-level, and is the remains of an ancient, more extensive lake; for Lake Posadas, separated from the said lagoon by a glacial drift, measures 400 feet, whilst Lake Pueyrredon, into which it flows, is scarcely 295 feet above sea-level. I have crossed the region some tens of miles to the east, and my attention was directed to the deep and extensive depression in which runs the intermittent stream, called Gio, and it would not be surprising if it corresponded to a very inferior level, and that this may be less than 330 feet above the sea. Unfortunately, when I was there I had not sufficient time to observe them. It cannot be said to-day whither the cavity of the saline lake extends, descending towards the centre of the valley, connecting itself with the actual depression of the river Gio; but, undoubtedly, it forms a part of the same transversal depression which stretches to the Atlantic to the south of Port Desire, and similar to those already mentioned. The southern cliff of the plateau falls almost vertically about 1600 feet down to the depression, whilst on the north it gently rises up to an isolated porphyritic mountain, which is visible from a long distance — Mount Colorado (4600 feet), at the base of which lies the Gio lagoon (1000 feet), fed by an important stream which runs from the west, and then, after descending, from the north, and rising at an altitude of 4625 feet.

The waters of Lake Gio lose themselves in the vicinity of its outlet and in the low plain which extends to the east, and to the east of the saline lake are other smaller lagoons and pools, whose waters do not reach the plain where it is crossed by the general road to the north. Lake Pueyrredon, an ancient tributary of the Atlantic, now empties itself into the river Las Heras by the west, after receiving the waters of Lake Brown, situated slightly more to the west of its centre. A little to the south of Lake Brown a river rises which flows west, and receives its waters from glaciers which also give rise to the river Lacteo, an affluent of Lake Belgrano, and to the west of Lake Brown there are other lakes still unsurveyed.

My assistants, overtaken by the snow, could not reach last year the end of Lake Pueyrredon, nor see, consequently, its outlet; but I have just received news from them, telling me that it empties by a short river into the river Las Heras, an important torrential river, as great or even more voluminous than the river Palena, situated more to the north. During my examination of Calen inlet, I discovered in the north-eastern arm a river of great volume and depth, descending from the north, but with such a strong current that it was impossible to row against it, and undoubtedly this river is the outlet of the network of lakes situated to

the north of Lake Belgrano, and to the east of the main chain of the Cordillera. I do not think this drainage is effected by any unknown river which may empty into one of the bays—Boca de Canales, Jesuit inlet, or Kelly bay. Another important river falls into the northern arm of the Calen inlet, and an enormous glacier is seen there which extends a great distance in this direction; whilst from the west, fed by great glaciers of the eastern slope of the main chain of the Cordillera, an affluent reaches the great river Las Heras, which is the outlet of Lakes Buenos Aires, Soler, the river Tamango, Lake Pueyrredon, etc. The river Tamango has its source in the immediate vicinities of that of the principal affluent of Lake Gio, and flows to the river Las Heras through another transverse depression, towards the west, a short distance north of Lake Pueyrredon.

The gorge of the affluent of the Gio, passing an opening in the plateau (4625 metres), continues towards the north by that of the river Jeinemeni, which, after receiving an affluent rising in a small lake at 2395 feet, empties into Lake Buenos Aires, the largest in Patagonia. Almost parallel with this river runs the one called De los Antiguos, owing to the native remains which are found there, and which correspond to races which no longer live in Patagonia, as I have ascertained after examination of some of their remains. The region between Rio Gio and Lake Buenos Aires is the most dreary that I know in Patagonia, and also the most sterile; it is covered with large lava-deposits from craters which are scattered over the fragmentary elevated plateau. The affluents of the river Desire, which I have crossed, have their sources there. There is nothing more desolate than this landscape, despite the vivid colouring imparted by the tertiary caps burnt by lava, rich in vertebrate remains, and overthrown from their primitive position by the subsidences which a central longitudinal depression has produced, and which follows the route bordered on the east and west by high plateaux capped with basalt. The contrast between the landscape at the foot of pre-Andine mountains and that of the main road across the table-land is worthy of remark. To the west, bubbling, crystalline streams run between the rocks and the forest, making the passage difficult,—the swamps and the abrupt mountains; to the east, a despairing monotony, always the black basalt line, the small bushes and shrubs—when there are any—and the glittering of broken pieces of obsidian which the gravel frequently contains; bare white and yellow cliffs, black wall, or white beds of dried-up lagoons, and here and there a large erratic boulder where the guanaco is hunted. The sole distraction for the traveller in those uninhabited regions are the ostriches and the guanacos. The Olnie rivulet waters the ancient district of the Tehuelches—"Olnie aiken" = "where there is grease," a favourite hunting-ground, the reputation of which has been handed down by tradition. The natives say that there was much more water there previously; that one of its

largest lagoons, dry to-day, was always filled; and that they could camp in any part of the wide lost valley, which is not the case to-day.

This route, between Lake Belgrano and Lake Buenos Aires, is interesting because it demonstrates the ancient distribution of waters in Patagonia and their subsidence. The same number of terraces can generally be counted from the main surface of the plateau: five important ones 165 feet in height more or less; and four varying from 65 feet to 20 feet, as though the causes which brought about the disappearance of the great lost lakes and rivers had been produced contemporaneously. Likewise this part, better than any other, confirms the opinion, already generally accepted, that Patagonia was covered by an extensive ice-cap, at least as far as the present coasts. The great granitic and quartziferous erratic boulders which proceed from the main chain of the Cordillera prove this, and when once the ice disappeared, the climatic conditions permitted the permanent existence of great rivers and lakes which eroded the surface, which was gradually uplifted. It is indubitable that a great portion of the lavas which are seen on the plateau to-day were deposited prior to the glacial period, but it is also certain that the eruptions have continued up to relatively very recent times, as, in some points, not the slightest vestige of erosion can be noticed on its surface, whilst at others it is polished and striated by the ice.

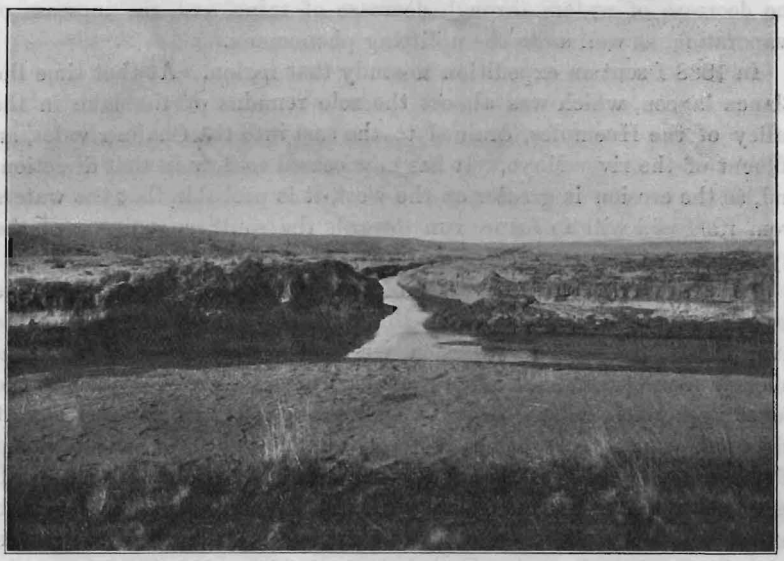
The division of the continental waters takes place, without a doubt, between the river Belgrano and Lake Buenos Aires in the same conditions as further south, that is to say, in the Patagonian plateau or in its depressions. The present affluents of the southern part of the river Desire rise in the volcanic plateau itself, and run northwards to enter gorges covered by the lavas of the last eruption, that is to say, subsequent to the time in which the transverse depression was formed and eroded, and which unite the fjord of Lake Buenos Aires with the Atlantic. Arriving at this depression, they run through the centre towards the east, to lose themselves in small lagoons and large pools before gaining the Atlantic. The western plateau turns in this direction in the ordinary form of a raised headland, overlooking, on the south, the vast anterior bay of the lake, separated from the first mountains by the gorges by which the rivers Antiguos and Jeinemeni descend. More to the west the landscape assumes its fjord-like character. To the east, also, the plateau, on which craters can be seen, stops and opens in this direction, leaving a vast and lower expanse on which other more modern volcanoes rise, and which corresponds to the transverse depression formed prior to the eruption of these volcanoes, which protect with their lavas the smooth caps of Patagonian tertiary land. On the north side the table-land is free of lava, but capped by a considerable bed of shingle. What an enormous quantity of glacial detritus is found in this true *paysage morainique!* Certainly in no part of Patagonia are the moraines so well preserved. On every side enormous erratic boulders, quartzites,

porphyries, and trachytes cap the undulations left by the moraines; and gneiss, for the first time, is seen amongst the detritus. In the flat cavities left by the retiring ice, small lagoons are seen, bordered by sand-banks; and springs, surrounded by rich pastures, abound. This ancient transverse depression has, to a great extent, been filled with volcanic ashes, which are visible in large layers, alternating with others of lacustrine and fluvial gravel.

Undoubtedly the transverse depression of Lake Buenos Aires is the largest in Patagonia. Since my visit in 1898, my fellow-worker, Mr. Waag, has succeeded in crossing the extremity of the lake and penetrating the river Las Heras which drains Lake Soler, into which Lake Buenos Aires flows. It is torrential and unnavigable. We thus have a further complete instance of the crossing of the Andean Cordillera by waters which rise to the east of it, taking advantage of the tectonic trenches, generally oblique to the axis of the main chain. All the transverse depressions of the Patagonian plateau correspond to large ancient fjords, the remains of veritable tectonic fractures, very probably produced by tertiary granite eruptions; and I think that the points at which the present rivers cut the chain are weak fractures which have been more easily and deeply eroded by the waters after the great masses of ice which covered and protected them had disappeared, and that this same melting process produced the wonderful erosions in the slopes of the Cordillera owing to the great quantity of resultant torrents. Lake Buenos Aires (985 feet) measures 75 miles in length from south-south-west to north-north-east, and is of similar type to the other large lakes mentioned—that is to say, partaking of the characteristics of both fjord and table-land lakes. In its extreme west it occupies a portion of the interior longitudinal depression which separates the main chain of the Cordillera from the isolated mountains. This depression stretches southward to Callen sound, and to the north it seems to extend a long way towards the eastern depression of the river Aysen, separating the cretaceous mounts Castillo and Ap Ywan (8625 feet) from the Cordillera proper. The west is overlooked by high snow-capped mountains, amongst them mount San Valentin (12,697 feet), with great glaciers. On the east the ancient outlet to the Atlantic is closed by modern volcanic ashes and fluvio-glacial detritus—first of all, those of the original moraine; and subsequently, those of the moraines left by the last extensions of the glaciers. In some parts of the western region the banks bear indisputable traces of the former level, and of its gradual and ever-increasing decline. These lines contribute to make the vast landscape, with its terraces and *roches moutonnées*, full of interest; and this is further increased by the picturesque calcareous islands, through which the waters have pierced their channels, converting them into so many *pots-à-arbre*. Springs, situated in beautiful prairies, are more abundant there than in the south, and it is certain

that within a short period the valleys lying between the eastern hills of the lake will be successfully made available for colonization. Last year I left a steam-launch there, by means of which the lake and its environs are now being carefully explored.

When delineating the aspect of the southern depression, and pointing out the present curious course of the Viscachas rivulet, I referred to the river Fenix. This river, rising in the Ap Ywan mountain, situated north of the centre of the lake, flows east-south-east for some 30 miles, and then abruptly turns to the west (1540 feet) to empty into Lake Buenos Aires. It runs between two lines of moraines marking the former extension of the last great glacier, which the lake subsequently occupied.



RIVER FENIX, NOW OVERFLOWING TO THE ATLANTIC AND PACIFIC OCEANS.

In consequence of one of the very common phenomena of capture to which these rivers are subject, the course of the Fenix has been turned towards the Pacific at one point from its ancient channel, and at such an insignificant level above low water, that, by working eight days with six men, we were enabled to send the waters back by their original channel to the Atlantic. This seems a practical demonstration of the fact that no mountains or hills existed there, and of the facility with which, by turning the waters in that direction, hundreds of miles could be easily colonized, which at present are regarded as useless deserts. If it was only when the ice melted in spring-time that the waters followed that course, to-day they have made it permanent. Lake Buenos Aires is merely a remnant of the enormous lacustrine deposit

which existed in this region in pleistocene and even recent times, as the first Spanish explorers who penetrated into Patagonia in the neighbourhood of Port Desire found rivers there which have since nearly ceased to exist.

Between the depression of Lake Buenos Aires and that of the river Senguerr, which drains Lakes La Plata and Fontana (3050 feet) to the Atlantic, another lacustrine depression exists, the waters of which have been drained off in part by the present channel of the river Aysen when once the breach was opened in the central chain of the Cordillera. The wide and deep valleys of Huemules, Mayo, and of Coyet once belonged to it, and their drying-up is due to the same general causes already mentioned—the accumulation of glacial deposits, the decrease of waters through decrease of rains, and the increase of evaporation, as well as to the uplifting phenomena.

In 1888 I sent an expedition to study that region. At that time the Blanca lagoon, which was almost the sole remains of the lake in the valley of the Huemules, drained to the east into the Chalia rivulet, an affluent of the river Mayo. It has now ceased to flow in that direction, and, as the erosion is greater on the west, it is probable that the waters from its basin will in future run towards the southern affluent of the Aysen, and will be tributaries to the Pacific ocean.

In the river Mayo I have seen springs of the river Coyaike, the central affluent of the Aysen, rise in the same source as those of this river in the transverse depression, which is narrowed there by modern volcanic rocks; and identical phenomena are produced close to it in the Coyet depression, where it is impossible to distinguish the point at which the waters separate in the two directions in the great depression of this name, and in that of Cantaush. The shores of the great lake are perfectly visible there; they are the remains of a much larger one, which extended as far as the present basin of Lakes Musters and Colhue, in the neighbourhood of the Atlantic, and the probable outlet of which was in the present Gulf of St. George. This eastern basin of the present Aysen is bordered on the west by the central chain of the Cordillera which is formed of high granitic mountains with large glaciers which considerably add to the waters of the river Aysen. It is bordered on the north by the Jurassic and Cretaceous hills which enclose Lakes La Plata and Fontana on the south. In this depression there are beautiful workable lands, and really picturesque landscapes abound, with open woods situated in the midst of beautiful prairies.

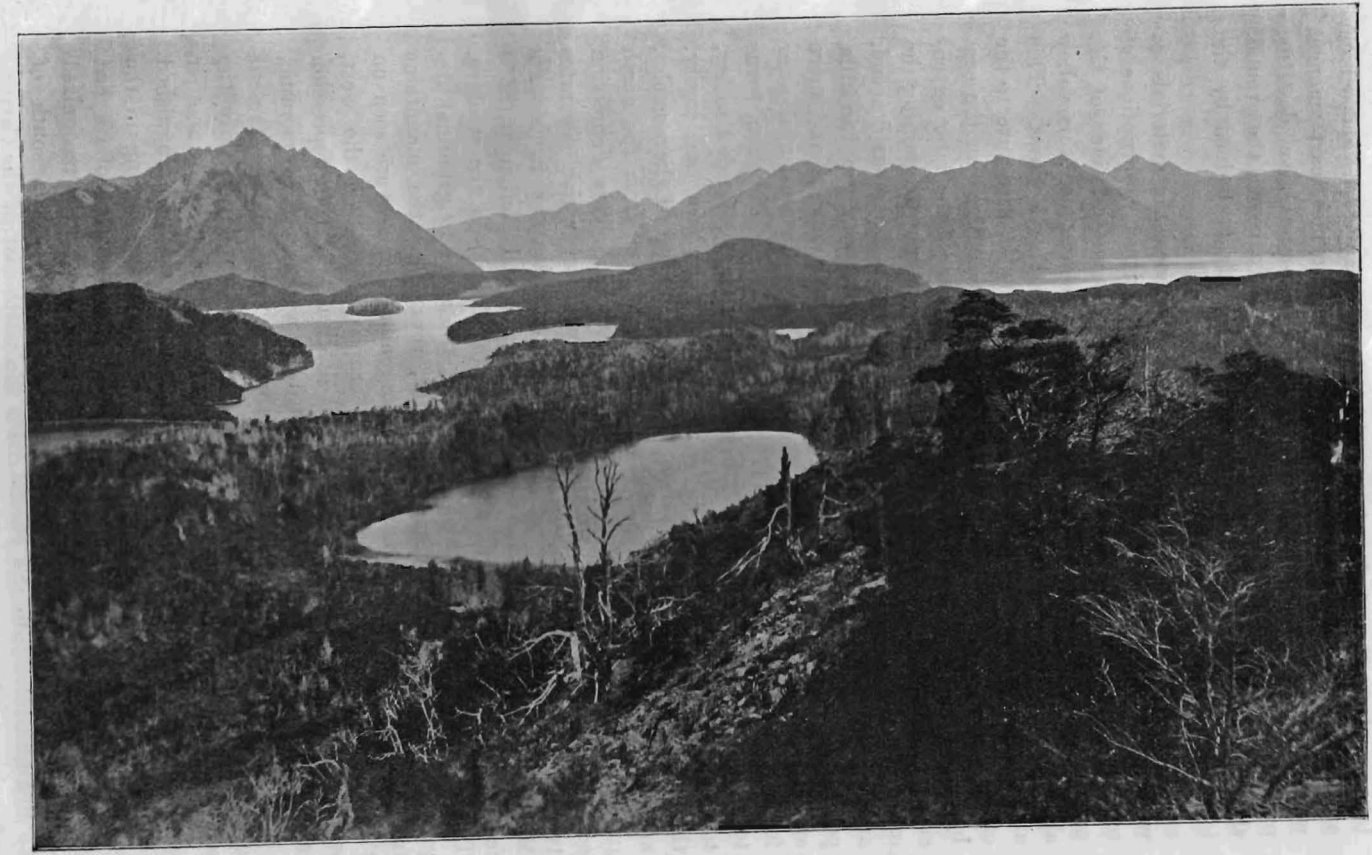
Lakes La Plata and Fontana occupy a fjord of another ancient great eastern lake, and have their outlet in the river Senguerr, which fed the river Chico of Chubut—that is to say, the southern affluent of the river of this name. I say "fed," because its waters ran to this river up to 1892, but since then the outlet is probably subterranean, as, according to the Indians, the water of the river Senguer has not decreased during the past seven years.

CORDILLERA OF THE ANDES, NORTH-WEST AND WEST OF LAKE BUENOS AIRES.

Lakes Musters and Colhue are now without outlet, and are themselves the remains of a much larger one, likewise part of the great pleistocene lake the depression of which is seen to the south of the present ones. According to my data, a great depression exists in this direction, with saline lakes.

Lakes La Plata and Fontana are situated at a greater altitude than Lake Buenos Aires, this being a repetition of the case of Lake Belgrano with respect to Lakes St. Martin and Pueyrredon; they are surrounded on the north and south by hills composed of similar cretaceous rocks, containing similar fossils; while on the west they are bordered by the granites of the central chain, and moraines enclose them on the east. The Katterfeld mountain, situated on its southern shore (5900 feet), is covered on its summit with glacial gravel. In the north the hills advance more to the east than in the south, and are composed, in the neighbourhood of the plain, of volcanic rocks, which at times cover cretaceous schists, and enclose beautiful valleys. We have discovered there numerous cretaceous fossils, both animals and plants, and coal has been observed.

The plain extends between these hills and the central ridges of Patagonia, at the base of which the river Genua flows towards the south to join with the Senguerr. These chains are composed partly of tertiary granite and porphyritic rocks, and partly of beds of upper cretaceous, probably containing saurian and mammal remains. This plain also forms part of a great lost lake which extended to Mounts Appeleg, Omkell, and Cherque, cut by the narrows through which, in ancient times, another lake drained, now also lost. It was situated between the hills to the north of Lake Fontana and the Putrachoique hills, in which depression, at the present time, the continental waters divide themselves amidst perfect morainic landscapes. This country is very suitable for colonization. While the waters which flow eastward empty, *viâ* the affluents of the river Genua, into the Senguerr, those to the west cut the Cordillera with the rivers Frias and Cisne, which empty into the Payuhuapi inlet on the Pacific coast, and with the river Pico, which feeds Lake Rosselot, which seems to occupy the continuation of the Payuhuapi depression, and drains into the river Palena, forming its principal southern affluent. The landscape seen from the highest point of the moraines (3600 feet) in the centre of the depression is interesting. To the east the mountains of Genua, rounded by the ice, which mountains are prolongations of the Sierras de Tecka, corresponding to a chain in the centre of Patagonia; while far to the west, only visible when the horizon is clear, the snow-capped crests of the Cordillera are seen; and yet nearer are the undulating forest-covered hills. A great number of terraces, forming depressions with fertile valleys, are indications of so many distinct levels; first of the waters of the primitive lake, then of the secondary



PENINSULA SAN TADEO, AT LAKE NAHUEL-HUAPI.

lakes, and finally of the rivers which have disappeared, and which are now converted into streamlets, hidden for the most part amongst woods and tall grass, which impede the traveller. Gravel detritus, presenting all the characteristic forms of its origin, covers the ground, the huge erratic boulders showing the great height attained by the ice and the waters of the lost lake.

Crossing the hills uplifted by modern volcanoes, the materials of which were ejected through the weak places produced by eruptions of tertiary granite which is seen in round patches on the sides of the present eastern valley of the river Carren-leufu, we reach this valley along which the central affluent to the river Palena flows. This affluent rises in Lake General Paz, which is similar in structure to the others (2820 feet), and the waters of which are confined on the east by the ancient basal moraine, and by the moraines of the later extension visible in vast semicircles. My assistants are now examining the interior of the lake with its various fjords, into which glaciers descend, and which are surrounded on the south-east by tertiary granitic hills, polished as whale-backs by ice, and by cretaceous schists and more ancient eruptive rocks on the west. The river Carren-leufu, after following at the outlet of the lake an east-north-east direction, turns to the north, and then to the north-west with a pretty wooded valley, to cross, in an east-west route, the main Andean chain, and empty, through the river Palena, the river Claro originating in Lake Rosselot, and the river Frio, an important affluent which flows from the north in a longitudinal depression close to the Pacific. This depression corresponds to that of Lake Rosselot, a depression which separates two high ridges of the snowy Cordillera culminating in Mounts Maldonaldo, Serrano, and Blanco on the eastern, and Melimoyu (8650 feet), Corcovado (7450 feet), and Yanteles (6725 feet) on the western. The river occupies, in its eastern third, the same longitudinal depression which extends from the south, separating the mountains from the terraces; the rims of the Patagonian terraces are seen on the east, and cretaceous and modern eruptive rocks on the west, while the valley is filled with glacial detritus. If this depression is followed towards the north, separated by a remnant of moraine, the beautiful valley of "16 de Octubre" is reached, the present location of a prosperous Argentine colony. This valley is only the bed of another dried-up lake, the remains, in its turn, of another much larger one, the lines of level of which can be easily distinguished on the slopes of the neighbouring hills. It is to-day sinking in the morainic terraces; its waters once flowed, at least those of its last depression, into the river Fta-leufu, which has been lately recognized to be the same as the river Yelcho, that drains to the south of the Reñihue inlet into the Pacific. To the north-east of the Carren-leufu plateau there are certain eruptive and volcanic rocks which

have broken up the ground, forming the high hills of the west of the present river Tecka, and which is surrounded on the east by the longitudinal depression which precedes the first ridges of the Cordillera. The Corintos rivulet rises in these hills, and has the reputation—though this is not thoroughly established—of possessing auriferous deposits, the upper lacustrine basin of which is the most appropriate for the study of the terrace-levels. I have counted twelve perfectly defined steps there. Before the opening of the Carren-leufu and Fta-leufu narrows, this basin was connected with the Atlantic on the east, draining through the river Tecka, on the shores of which perfectly distinct traces of level are seen. At the present time, at the bottom of the ancient channel

LAKE VIDAL GORMAZ, FORMED BY ALLUVIAL FANS IN THE SOUTH-WESTERN ARM OF LAKE NAHUEL-HUAPI.

of the outlet, waters rise which flow to both oceans, separated in the Zunicaparia swamp by a ledge of shingle not more than 30 feet higher than the present streamlets.

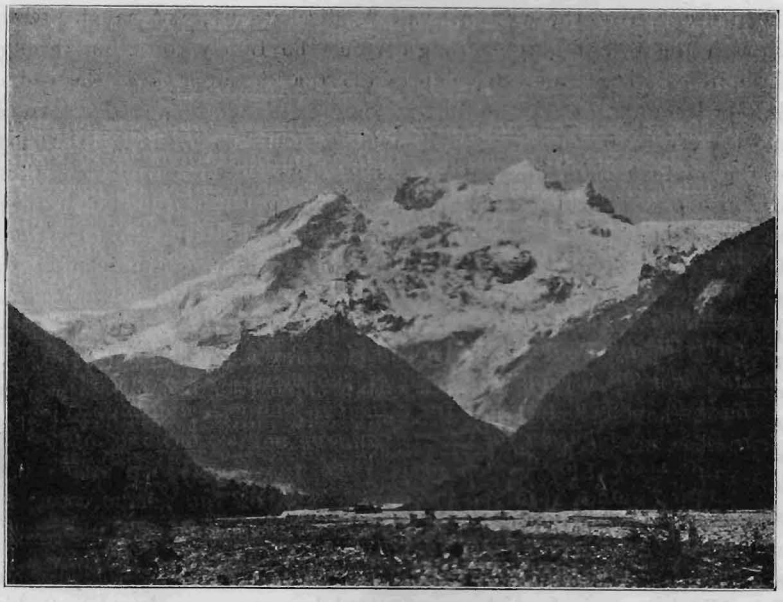
I have said that the river Fta-leufu at present receives the waters of the valley of "16 de Octubre" (1085 feet). It also receives those of a vast northern area now bordered by moraines separating the waters which empty into Lake Cholila (1705 feet) from those flowing to Lake Puelo (560 feet), which, in its turn, flows through the river of the same name into the inlet of Reloncavi on the western coast of the continent. This opening, which separates Situation mountain (6690 feet) ridge immediately to the west of the valley of October 16 from the lateral chains of the Cordillera proper, contains a series of

beautiful lakes, the principal ones being Ftalauquen (1560 feet), Menendez (1590 feet), Rivadavia (1640 feet), and Cholila, which are chiefly fed by waters from the glaciers of the central chain, called the secondary chain by some Chilian geographers, and on the western slope of which various important rivers, tributaries of the Pacific, rise, such as the Corcovado, the Reñihue, the Bodadahue, etc. That chain, which I consider as the main chain of the Cordillera, extends from Fontana lake to the north, and joins the one which is overlooked by the beautiful Mount Tronador on the west of Lake Nahuel-Huapi, being cut by the rivers Cisne, Palena, Yelcho or Fta-leufu, Puelo, and its affluent the river Manso. The lakes named, supplying waters to the river Fta-leufu, are the remains of fjord-like arms of the great lake which, in other times, existed between the main chain of the Andes and the mountains of the centre of Patagonia, situated on the east of the river Tecka. These lakes were once covered by an extensive glacier, judging by the enormous erratic boulders, hundreds of cubic yards in size, which I saw deposited on the volcanic hills of the Apichig gorge, at an altitude of 650 feet above the present plain, and in the neighbourhood of which is the northern boundary of the lost lake. Before disappearing, this lake was divided into various fractions, separated to-day by glacial deposits; and in its depressions another secondary parting of the waters of the continent was formed. In the plain of Cholila, the northern affluent of the Chubut flows on the east; and the waters rise there which empty into the basin of the river Puelo, tributary of the Pacific; while springs from the same moraine reach, through the southern lakes, to the river Fta-leufu, also tributary to the Pacific.

To the north of this depression, and separated by Epuyen lateral ridge, cut in its turn by the waters of the lake of the same name, another one, in which Lake Puelo occurs, is situated, which formerly extended to the vicinity of the southern fjords of Nahuel-Huapi, but is now divided into two parts. The waters of the southern one emptying into Lake Puelo, to quit it in the turbulent river flowing to the Pacific by the narrow gorges of the main chain of the Cordillera, while the northern one feeds the affluents of the river Manso, which also traverses the main chain to flow to the river Puelo.

I have pointed out that the ancient lake of the depression of the valley "16 de Octubre" emptied in a previous epoch into the Atlantic *viâ* the river Tecka, now an affluent of the Chubut. To the north of the ancient channel stretch a series of hills separating a secondary longitudinal valley, situated on the east of the Esguel and Lilig hills, which was also the bed of the same lake; this is easily recognized by the strata which are observed in the cuttings of the streams that at present cross it transversely. This depression extends northward to unite with that of the northern arm of the Chubut, and is separated

from the latter by an extensive moraine reclining on a volcanic hill. The northern arm of the Chubut penetrates through the continuation of the longitudinal depression, also crossed by deep transverse gorges, outlets of the different levels of the ancient lake as it shrank its proportions. It extends to the north until it reaches the high plateau which separates the depression of the river Chubut from that which corresponds to the river Limay; and, likewise, another transversal valley, in which at a previous epoch existed the river carrying the waters of the Nahuel-Huapi to the Atlantic by the present San Antonio bay. This plateau, also formed by different terraces, and covered with the remains of the glacial period as far as the western



MOUNT TRONADOR, IN THE MAIN CHAIN OF THE CORDILLERA.

hills, overlooks the entire eastern depression of the river Manso, which separates it from the lateral ridges that precede the veritable Cordillera, and various springs rise in it—some affluents of the Chubut, and others of the basin of the Nahuel-Huapi lake. It has, on its western edge, a chain of cretaceous hills, which in some parts attain an altitude of 7000 feet, with peaks consisting of a porphyritic rock, which, mingled with the dark grey of the schists and the green of the trees of the surrounding forests, gives a vivid colouring to the mountain.

The descent from the plateaus to the plain of the ancient extension of Lake Nahuel-Huapi is rather long, and on its sides erratic rocks abound, which are not generally found at the bottom of the depression,

except in the deposits that correspond to the second advance of the glacier, the last moraine of which surrounds the present lake, which undoubtedly is the most beautiful in Patagonia. If the present extension of the lake is great, and its western channels penetrate to the heart of the Cordillera, this extension was, in a relatively recent period, much greater. The series of small lakes I have referred to, which now empty into the river Manso, are remains of arms of Lake Nahuel-Huapi. The waters of this extended, in recent times, to the present Limay narrows on the north, and washed the base of the Cordillera nearly to Lake Traful; in the south they filled the fjords where Lakes Vidal Gormaz (2330 feet), Guillelmo, Mascardi (2570 feet), Gutierrez (2575 feet) and others smaller, are found to-day; and on the east they filled all the depression of the present valley, discharging, not as at present through the recent gorge through which the Limay flows, but through the still existing transverse depression that terminates at the end of St. Matias gulf, called the Bay of San Antonio. The eroded terraces and the erratic boulders which I have mentioned as being on the slope of the plateau indicate that extension. At present the waters are diminishing, either through erosion having produced greater drainage outlets, decrease of rains, or evaporation, so that the lake has been divided; but in its extreme north-west its remains are seen in the beautiful Lakes Espejo and Correntoso, which occupy the longitudinal fjord peculiar to all the great Andean lakes already named, and separated from the present Nahuel-Huapi by small alluvial cones; on the extreme west similar lakes are seen in another ancient fjord. In the south-west, Lake Gutierrez, situated at an altitude of about 150 feet above the present Nahuel-Huapi (2430 feet), primarily formed by the terminal moraine of the glacier of the fjord, is only separated by a cone of sediment 50 feet high from Lake Mascardi, likewise the remains of the same fjord. While the first discharges into the same lake, the second has its outlet to the west and south after receiving the waters of Lake Vidal Gormaz, through a very recent deep gorge, produced, probably, in part by volcanic phenomena, until it encounters the eastern valley of the river Manso. The ancient fjord south of Lake Nahuel-Huapi previously penetrated slightly more to the west than the present arm of Port Blest in the same central chain, at the southern base of Mount Tronador, which chain extends to the south, separating the waters that fall into Lake Gormaz from those forming the river Cochamo, which discharges directly into Reloncavi inlet. Mount Tronador, the king of this part of the Cordillera (10,860 feet), distributes the waters of its glaciers to Lake Nahuel-Huapi and Todos los Santos, its western congener. The river Limay is now the outlet of Lake Nahuel-Huapi, its course having pierced an outlet into the ancient valley of the lake, and joined the ancient river which collects also the waters of the northern longitudinal depression in part. The rivers Caleufu and

Chimehuin are affluents to the river Collon Curá, which carries to the Limay all the waters of the eastern Andean slope from parallel 37° 30′ through the continuation of the general eastern depression. The character of the region is generally the same as in the south. Lake Traful, which discharges into the Limay by the river of this name, occupies one of the many transverse fjords already mentioned. It is deep, like all the Andean lakes, and very beautiful with its picturesque granitic and volcanic mountain groves and wooded islets, overlooked on the west by the central chain, and on the east by the terminal moraines of the ancient glacier.

VOLCANIC TUFF AT RIVER LIMAY.

The river Caleufu carries the waters of the lakes Villarino, Falkner, Filohuehuen, Hermoso, and Metiquina to the Collon Cura; while the river Chimehuin no longer receives all those of the east Andean slope. In relatively modern times, between the Sierras de Chapelco and de la Virgen, a great lake existed, the present remains of which are Lake Huechulafquen (2820 feet), in which the beautiful cone of the Volcan Lanin (12,140 feet) is reflected, and the lakes Lolog and Lacar. To-day only the two first named discharge into the Atlantic; the third, which emptied on the east into three rivers, the beds of which are perfectly preserved, is, on the contrary, a tributary of the Pacific, its waters turning into the river Huahuma, which has cut through the main Andean chain, which is there called the Cordillera de Ipela (7500 feet). An altitude of scarcely more than 5 to 10 feet at the base of a moraine

separates the waters of the river Quilquihue, the outlet of Lake Lolog (2920 feet), from those of the Calfuco stream, affluent of Lake Lacar (2200 feet); and at that point, at the base of the remains of the plateau, a spring exists, which sends water to the two streams.

The valley of the Chimehuin is already the seat of a prosperous township, Junin de los Andes (2560 feet), which will become the emporium of the riches of those regions so soon as a sufficient population arrives to exploit them, and the trans-continental railway is constructed on the route indicated by Captain Fitz Roy in 1834 as being the easiest means of communication between the Atlantic and the Pacific, which is that of Puerto San Antonio, on the Bay of St. Matias.

The region in the neighbourhood of Junin de los Andes, watered by the rivers Chimehuin and Malleco, is one of those which has the best future before it in the Neuquen territory, in Northern Patagonia. It possesses extensive pasture lands, the Araucaria forests beautify its landscapes with their fantastic foliage, and strawberries abound in the proper season, amongst the apples introduced in very early times. On the west, projecting over the lower mountains, are still active volcanoes, such as the Lanin (12,140 feet), whose glaciers diminish from year to year; the Quetrupillan (9185 feet), with its truncated cone; and the Villarica (9675 feet), picturesque in its forest groves. As one advances northward, after passing the high primitive plateau of Pichi-Nahuel Huapi, one finds verdant valleys with charming lakes, gorges cut through the granitic rock, capped with lava, offering a most beautiful and varied prospect—the green prairies alternating with the forests. The river Alumine receives the waters of these lakes, as well as of the torrents and those of the picturesque lake of the same name, which penetrates to the heart of the Cordillera, and is surrounded by characteristic moraines; while on the east abrupt fields of lava are in the Catalin ridge—an independent mountain, which forms no part of the Andean Cordillera. The northern affluents of the Aluminé are separated from those which form the river Bio-Bio by a tall moraine (4580 feet) of the ancient lake which occupied the eastern depression of the Bio-Bio when its waters ran into the Atlantic, before the opening of the cañon through which it now empties into the Pacific. It is a region of great interest, from various aspects, about which, however, I must not say more now, as it would be foreign to the object of this lecture.

To conclude this lecture, the extent of which prevents me going more fully into details, I think it advisable to give the following summary:—

Starting from the Atlantic coast, we find in Patagonia a denuded tertiary and sometimes cretaceous table-land extending from the Rio Negro to Magellan Straits, interrupted in its geological uniformity

by the ancient eruptive rocks and archean schists of San Antonio, Point Atlas, Santa Helena, and Port Desire, which are the effects of analogous formations from further inland, and constitute the almost obliterated central chain of Patagonia, the remains of which are Mounts Calgadept, Talaguepa, and Los Martires, and those near Lake Musters. This plateau is cut by large transverse depressions, the principal being the Hualichu depression on the south of the Rio Negro, the Maquinchau and Balcheta, through which previously emptied the waters of Lake Nahuel-Huapi, the present Chubut, Senguerr, Chico, Desire—ancient outlet of Lake Buenos Aires—to-day nearly exhausted,—the

VOLCANO LANIN, FROM THE VALLEY OF THE MALLECO.

analogous river Gio, which is between the Desire and the totally disappeared river San Julian, which has connected probably Lake Belgrano, by the river Chico, with the Atlantic; the depressions of Lakes San Martin and Viedma, the river Shehuen, the Santa Cruz, the Coile, and the Gallegos.

Besides these transverse depressions, which are now, or were, occupied by large rivers, other depressions are found in the plateau, which were occupied by more or less extensive lakes, having their outlet through these transverse valleys, such as the Yagagtoo, Musters, and Colhue, and others situated on the south of Port Desire, in the centre of the country.

These plateaus are covered, on the greater part of their surface, by a cap of loose glacial, and in some parts by fluvio-glacial, gravel, which

barely supports the growth of some coarse pasturage and a few bushes on the shores of the northern rivers. At the present time, good pastures are only found on the watered lowlands, where bushes are more numerous, but, by irrigation, extensive lands can be cultivated in the whole of the country. In the central region, volcanic eruptions, which have taken part in the formation of the plateau, from the tertiary periods down to the present era, cover an important part of it with basaltic lava-caps; and in the western third recent glacial deposits appear even above the lavas. The plateau terminates at the base of the first lateral hills preceding the Cordillera of the Andes.

There, in contact with folded cretaceous rocks raised by the tertiary granite, erosion, produced principally by the sudden melting and retreat of the ice, aided by tectonic phenomena, has scooped out a deep longitudinal depression, which generally separates the plateau from the first lofty hills, while on the west of these—which generally form small ridges or isolated hills—a similar longitudinal depression is observed which precedes the veritable Andean Cordillera. This depression contains the best and most fertile lands of Patagonia. The geological constitution of the ground is in accordance with the orographic physiognomy. The tertiary plateau, horizontal on the east, gradually rising on the west, shows upper cretaceous caps at its base. The first lower cretaceous hills, raised by granitic and dioritic rocks, probably tertiary, and then, on the west, metamorphic schists of uncertain age; then quartzites appear, resting directly on the primitive granite and on the gneiss which form the axis of the Cordillera; while porphyritic rocks are seen between the schists and quartzites. All these rocks are covered with the remains of the ice-period, which are not only observed in Patagonia, but also in the whole western region of the Argentine Republic. I have seen moraines and glacial lakes on the Puna de Atacama, and on the mountains in the province of Salta as far as parallel 23°, and I have found perfectly characteristic ones in the provinces of Catamarca, Rioja, San Juan, and Mendoza. There the glaciers have descended to the level of the present plain (2400 feet). The glaciers occupy the valleys of the main chain and some of the lateral ones of the Cordillera. Many, on the west, descend to the sea to lat. 44° 30′, and, on the east, to the lakes, strewing them with icebergs; while several of the high peaks are still active volcanoes, among which I should mention three little known—one situated to the west of Lake Dickson, according to the Indians; another, the Fitzroy volcano; and the third was seen from the Argentine vessel *Azopardo* from the sea, in about lat. 47° 30′.

In Patagonia an immense ice-sheet extended to the present Atlantic coast, and further east, during the first ice-period; while, during the second, terminal moraines have been generally left as far as 30 miles north and 50 miles south to the east of the present crest of the Cordillera. These ice-sheets, which scooped out the greater part of

the longitudinal depressions, and appear to have rapidly retreated to the point where the glaciers now exist, did not succeed in filling with their detritus, in their rapid retirement, the Cordilleran fjords now occupied by deep lakes on the east and by the Pacific channels on the west. Soundings taken in these channels (which have reached 250 fathoms in some fjords) show that the depth of these fjords is greater in the vicinity of the mountains than to the west of the islands; and probably a longitudinal depression exists there analogous to the one which preceded the plateau on the east, and limited by a submarine plateau to the west.

It is evident to me that we have in Patagonia a portion of the Antarctic continent, the permanency of which, in so far as its main characteristics are concerned, dates from very recent times. When, lately, I went through the western, *i.e.* the Pacific channels, my attention was directed to the islets in close proximity to Chiloe—between that large island and the Cordillera—they appeared to me to be of very recent emersion, and I recalled Darwin's interesting observation, when he noticed that, in Chiloe, various promontories, joined by extensive beaches to the mainland of the island, are called "huapi," the Araucanian equivalent for "islands," thus perpetuating, perhaps, the recollection of the time when they were islands. Those of the islands I was able to see were composed of caps of shingle, with great, more or less rounded, boulders, of sand and volcanic ashes, essentially of the same form as some of the remains of the Patagonian plateau.

To those who have studied the pampean formation, it is well known that the actual land of the Buenos Aires province must have extended eastward in recent times, and that the advance of the sea, and the salt-water deposits left by it when it retired, forming some of the lowlands which are seen on the littoral and even in the interior of the pampas, are much more recent. Likewise certain caps of shingle derived from rocks of a different class to those of the neighbouring hills, which are observed on the Atlantic coasts of the same province, increasing in quantity and size as one advances southwards, seem to indicate that the caps of shingle which now cover a great part of the Patagonian territory extended more to the east on emerged land which has now disappeared; while other marine deposits seen on the same coast appear to have been turned into bays during the subsequent advances of the sea. Besides, in the neighbourhood of the present coast, even in the very province, deposits of volcanic ashes are found; and the ocean deposits on its shores blocks of basaltic lava, which probably proceed from eruptions of volcanoes now under the sea, similar to those to which I have referred in Patagonia. But one of the facts which seems to me to demonstrate with greater certainty the existence, in recent times, of land now lost is the presence of the remains of the pampean mammals in pleistocene deposits in the bay of San Julian, discovered by Charles Darwin, and

in Santa Cruz, where I have myself gathered them. These animals lived there in the intermediate period between the great ice extension of the Patagonian inland ice and the second period, and, undoubtedly, reached that point from the east, as it is not presumable that they advanced from the north to the south over the plateau cut by the great (now lost) rivers, all of which contained ice in abundance. The presence of extinct animal remains in Patagonia in the vicinity of the Cordillera, demonstrated by the discovery of the skin of the so-called *neo-mylodon* in the cave near Last Hope inlet, to which reference has already been made, may be explained, I think, by supposing that the animal to which this piece of skin belonged penetrated from the east to the neighbourhood of the Cordillera in the intermediate period between the two glacial extensions, the piece of skin being preserved till now, owing to the favourable nature of its surroundings.

So, then, the history of the Patagonian plateau is connected with the problem of the southern continent, which, to so great an extent, has disappeared. The discovery in its geological caps of vertebrates closely allied to others found in South Africa, and Australia; the large fossilized tortoises of the province of Buenos Aires, analogous to those found in the islands of the Indian ocean and in the Galapagos; the discovery of dicotyledonous plants in the Andean cretaceous formations, among others, apparently, remains of the eucalyptus—are all in favour of those who maintain the existence of those lands and their disappearance in recent times. It is known that the Patagonian tertiary formations—abounding in mammalian remains—are, in their major part, lacustrine deposits, formed of sand, caps of gravel, and volcanic ashes; but the great lakes which these deposits formed were extended to the east, as is demonstrated by the cliffs of the Atlantic coast, and as these deposits occupy the greater part of the present Patagonian territory, it may readily be admitted that when those animals lived, the continent had a very much greater extension in that direction.

The whole of this vast region of Patagonia is very thinly peopled; even the Indians, never very numerous, are dying out, and colonization has not progressed as it should have done, seeing that land exists there which would support a considerable number of human beings. However, in the neighbourhood of the river Gallegos, numerous cattle farms have been established, and the cattle are developing admirably; Gallegos city consequently prospers. Also in Santa-Cruz the village grows rapidly. To the north of the river Chubut valley, where, in 1865, the Argentine Government formed a colony with Welsh settlers, the soil has been fully developed, the finest wheat of the Argentine Republic being grown there. Another colony is situated in the valley "16 de Octubre" near the Cordillera; while in other parts of the territory, cattle estates are met with, which are being successfully developed, principally in the neighbourhood of the Gulf of Saint George. The Argentine

Government has now turned its attention to the southern lands of the Republic. All danger of international complications having disappeared, the first step of the Government was to exchange contracts for war material, amounting to over a million pounds sterling, into contracts for railway material for immediate use in the construction of the projected line of railway between the Atlantic and the Andes, starting from the port of San Antonio, which was considered by Captain Fitzroy, early in 1834, as the best route for communication with Chile; while surveys for irrigation works are being made at this moment, and plans for irrigation are now being elaborated which, when completed, will easily change the desert aspect of a large portion of Patagonia.

WOOD OF ARAUCARIA IMBRICATA.

And it is very satisfactory to learn that on June 1 the great southern line will be opened as far as the junction of the Limay and Neuquen rivers with the Negro river on its way to Nahuel-Huapi, the most lovely lake in South America. Here and there the traveller finds a Tehuelchian or Gennaken encampment, but natives of pure race are now very scarce; it would be difficult to gather together fifty true Tehuelches, and the number of Gennakens cannot be much greater. The remaining native population is composed of the ancient Araucanian race, or a mixture of the three races. But these do not represent the only type of human beings which have dwelt in Patagonia. In ancient burial-places I have collected the remains of other—now totally disappeared—races, which were quite distinct from the present ones, but which greatly resembled the primitive types met with more to the north,

in the Chaco and in Brazil, while others strongly resemble some Pacific races, possessing ethnic characteristics which have not been observed in South America. Among these remains, every type of artificial deformity of the skull hitherto known is found; while to-day the natives only preserve the occipital deformation. This variety of extinct human types should of itself form the subject of a serious investigation. Patagonia is the extremity of the American continent, and has been the last refuge of more than one people in their forced exodus. For the purpose of study, I have handed to the staff of the British Museum, duplicates of the extinct and present animal remains of Patagonia, and of its flora, which I collected in my excursions, as well as of those obtained by the *personnel* of the La Plata Museum, of which I am the director; and I trust that, with such competent collaboration, it will soon be easy to give an exact idea of Patagonian biology, of which I must not treat at this meeting.

The physiographical facts which I have sketched in broad outline show how interesting the lands of Patagonia are to the geographer, the geologist, the zoologist, and the botanist.

I do not think I shall be accused of exaggeration when I say that the study of the extremity of South America, where Charles Darwin received the first impressions of his grand ideas, and which, nevertheless, has since been so neglected by English scientific men, is, among the less-known regions of the Earth, one of those which should awaken the greatest interest. The Argentine Republic, owning the chief part of this territory, as a new country, does not yet possess a sufficient number of persons for carrying out the investigations I have alluded to, and would welcome those who might go there for the purpose of such studies. I have no doubt that both the people and the Government would efficaciously co-operate to make their visit a success. The climate is healthy; there are no great difficulties in travelling in the country, even in its most unknown regions, and, with that perseverance which is inseparable from true knowledge, the results which would be obtained would be extraordinary. So I take the liberty of proposing that our Society, with the co-operation of the British Museum, the Royal Society, and other institutions which take interest in this class of studies, should procure the means of realizing these investigations. It is to be desired that, at the time at which the Antarctic Expedition takes place, a complimentary one should be despatched to the Argentine Republic with the object of studying its territory, seeing that it cannot be extraneous to that of the antarctic regions; for already many persons think that these regions are the remains of an extensive continent which, in more or less distant periods, included, among others, a part of the Argentine territory. Perhaps a brief statement of some of the points to be investigated would show how great the need was for it.

A great part of the extension of the Andean Cordillera is completely

unknown, both as to its topography and its geology, and yet its study is of the utmost importance, in view of the problems, the solution of which depends upon it. It is not hazardous to say that the ideas current with reference to its formation and constitution do not correspond with the facts, and I will say the same as to other mountainous regions of my country. Very few countries are more appropriate for the study of vulcanism and the movements of the Earth's crust, the activity of which now causes constant tremblings, which are felt up to the eastern regions of Bolivia, producing tectonic phenomena requiring immediate study.

The formations of the plains of Argentina, of its renowned Pampa, and of the Patagonian table-lands, are problems still waiting solution, and claim the direct attention of experienced observers, as well as an investigation into the origin and development of the animals and plants —principally of Patagonia—the fossil remains of which have so greatly interested palæontologists, who anticipate that they will fill up many of the great gaps existing in the knowledge of the vital evolution in the Earth.

Much new material for zoologists and botanists would result from the exploration of the mountains and woods in the north of the Republic, and of those of Patagonia and its coasts; the fauna of the Andean lakes is still a mystery.

Physiography has much to gain from the study of the process of the formation of the present features of this part of the Earth; it would be difficult to find another country where the action of the ice could be so easily studied, as well as the phenomena of erosion and denudation.

Those who are engaged in the study of the past history of mankind, would find an ample harvest of new data—many of them unforeseen—which would open out vast horizons, by exploring the vestiges of lost or nearly extinct races—some half civilized, others nomadic, which can still be found in the Atacama high lands down to the end of the continent.

And, finally, those who desire to investigate with that personal knowledge of the ground which so greatly strengthens one's convictions, the economic value of the physical conditions of that territory, will receive compensation for their labours in being able to say that human energy possesses there a vast fertile field for its exercise.

Science would gain much from this class of investigation; industry and commerce would profit thereby; and—why should I not say it?—my country also, which is to-day engaged in effacing the errors of the past, would gain in every way, when once unbiassed men, accustomed to observation, give expression to their opinions as to the nature of its soil, and as to what it might be expected to sustain if properly exploited. It seems to me that investigations carried out in this way would have a practical result in every sense of the word.

Before the reading of the paper, the PRESIDENT said: This evening we are to hear a most interesting paper from Don Francisco Moreno, the great South American geographer and geologist. About two years ago I wrote a paper for a magazine in America, on the subject of the countries which have not yet been discovered, and I put a long black mark along the eastern side of the Patagonian Cordillera. That black mark has now to be removed. Don Francisco Moreno has since brought the news to us of his important discoveries in that region; he has also brought a great number of maps and most beautiful photographs of the country explored, and he has communicated to us a very full and very valuable paper, which will be printed in our *Journal*. This evening we can only have a brief abstract of that paper, and Señor Moreno will show us a number of his photographs.

After the reading of the paper, the following discussion took place:—

DON FLORENCIO L. DOMINGUEZ, Minister of the Argentine Republic: I thank you most heartily for the kind words in which you have introduced the name of my country, and for the cordial reception given to Señor Moreno. The Royal Geographical Society, which has so many titles to the consideration of the learned men of the whole world, is looked upon in the Argentine Republic with genuine sympathy for the interest it has always shown in the investigation of the features of a country which offers so many natural attractions to the traveller and such a wide field for scientific investigations. The learned President has shown in his works a thorough knowledge of the South American continent and true sympathy for the efforts of their sons in developing and making known the vast resources of their own countries. As to my own country, this is not the first time that he has spoken kind words. It has been my pleasure to listen to him in similar circumstances as those that have gathered us here to-night, when a fellow-countryman of mine, an officer of our navy, gave an account of his travels in the wild regions of the Rio Bermejo; and not long ago, only last year, in welcoming an English traveller after his gallant attempt to climb Aconcagua, he spoke in eloquent words of General San Martin's memorable achievements in crossing the Andes with an Argentine army in order to complete the liberation of two sister republics. Sir Clements has followed with kind interest the explorations of our own travellers, the works of our writers, and his opinions are the result of his deeply rooted convictions.

The Argentine Republic, as a whole, is not unknown in Great Britain. Our commerce is of great importance; we receive from the United Kingdom far more merchandise and products of the industry of her people than from any other country, and in exchange Argentina sends to this hospitable land the natural products of her soil and of her camps, which contribute in some extent to the well-being and comfort of the sons of this great empire. There are in the museums and other institutions of this country many objects which show the Argentine Republic under a scientific aspect, but there are, however, portions of the country which contain, perhaps, unravelled features and secrets worthy of investigation by those whose aim is the expansion of human knowledge. We have always welcomed those men, and it is our invariable rule not only to keep an open door, but to give free access to our territories to all those who, seeking a high ideal, come to our shores in search of new elements, to irradiate after the light they have gathered. The name of Darwin, not to mention any other, will always be fresh in the memory of the Argentines.

Dr. WOODWARD: I can only testify to the great advantage which the British Museum has derived from Dr. Moreno's generous assistance, in presenting to the natural history branch of our museum numerous objects from Patagonia and from the Argentine Republic generally. As you are aware, sir, he is the Director of the

great museum at La Plata, and those who have visited that museum can testify to the splendid work he has carried on there, in addition to the enormous labours, which you can judge by the character of his paper to-night, he has expended on this vast region of Patagonia.

From the geological point of view, no doubt there is no country that has been under exploration of late years offering so grand an opportunity to the geologist and geographer; the lakes, plateaus, and river systems must afford enormous fields for investigation in pure geological work. But more interesting to us, who are connected with the museum, are the wonderful Tertiary and Cretaceous deposits, containing such a remarkable fauna of both mammals and birds. This region was touched upon so long ago as the forties by Charles Darwin, and visited at various points by Admiral Fitzroy. Since that time very little exploration has gone on until now; we have laid open all at once a region rich in a new mammalian fauna, which will probably result in an extraordinary extension of our views as regards the geographical distribution, in Tertiary times, of the mammalia of the Southern Hemisphere. That we find in a region like Patagonia evidence of mammals which have their relations in Australia seems an extraordinary thing; but it is not improbable that some marsupials, which have been discovered in these Tertiary deposits of South America, may be related by descent with those of Australia, and therefore, in connection with what Dr. Moreno has said in regard to the importance of Antarctic exploration, it is quite justifiable to add the exploration of this region to that of the Antarctic; because it is possible, and strongly believed by many naturalists, that there may have been a former connection between these lands and the antarctic continent and the lands on the other side of the hemisphere.

With regard to Dr. Moreno's work in connection with geology, I have said sufficient to point out the great obligation we are under to him in making known and bringing examples of these various forms of animals to our museum. We have had visits paid to the La Plata museum by Mr. Lyddeker, Mr. Arthur Smith, Mr. Woodward, Mr. Oldfield Thomas, and others, and I hope we may look forward to closer inter-relationship between the Argentine Republic and this country, which will be of the greatest service in the promotion of natural science generally.

Dr. GREGORY: I have had the pleasure of reading the paper, and therefore have much pleasure in joining in your tribute to its great importance to Patagonian geography. At this hour of the night it is not possible even to refer to all the points upon which it throws light. I might perhaps mention three.

First, the probable connection of Patagonia with the antarctic continent, which renders it necessary that its natural history should be worked out before the collections from the antarctic expedition are brought home; as otherwise it will not be possible to get great results from these collections.

Second, there is the question of the relations of the fauna and flora of Patagonia with those of Australia and the Cape.

Third, there is that remarkable instability in the geographical structure of Patagonia which seems to have caused great geographical changes in recent times.

As I heard the paper I could not help being reminded of the passage in Charles Darwin's book on Patagonia, in which he said it seemed as improbable that any country could have kept unchanged in position throughout a whole geological period as that the atmosphere could have kept absolutely calm throughout a whole season. That probably seemed a sensational exaggeration, but when we read the evidence brought forward by Señor Moreno, and the great geographical changes that have so recently occurred, that remark seems justified. I can only hope that the invitation Dr. Moreno has given will be taken up, and several typical areas in

the country deliberately worked out by some expedition, sent out on a scale commensurate with the important work.

Colonel CHURCH: Many explorers have given us scraps of geographical information regarding Patagonia, and sharpened our appetites for more knowledge of that *terra incognita*. Since our childhood, we have allowed our fancy to play with its mysteries, and have longed for some bold explorer to thoroughly penetrate them. The world has scarcely known that, quietly, but intelligently and indefatigably, a great Argentine traveller and *savant* was busily engaged in gathering for us what we so longed to possess; and therefore we give no ordinary welcome this evening to Dr. Moreno, who lays before us the geographical treasures which he has accumulated, the rich fruits of many years of wanderings and careful studies in the interior of that, thanks to him, no longer unknown land.

I have seen much of the coast-line of Patagonia, but have never penetrated its interior. Some of the fjords and islands among which I have voyaged, on its west coast, are marvellously beautiful. In all of the gorges of the low mountains, glaciers pour from beneath them streams of water from such an elevation that they break into mists before striking the ocean, and are spanned by rainbows.

The line of coast from the island of Chiloe to the Straits of Magellan is one of the rainy regions of the world. A great antarctic current strikes Tierra del Fuego on the south side. A fraction of it takes a direction a little to the north of east towards the Cape of Good Hope; but the mass of it finds its way along the west coast of Patagonia, under the name of the Humboldt current, until it is lost in the mighty equatorial stream which moves majestically westward across the Pacific ocean.

On the Atlantic side of Patagonia, we have another equatorial current setting southward, and so heated that, on any parallel of latitude between the mouth of the Plata river and the Straits of Magellan, it is six degrees warmer on the Atlantic side of the continent than it is on the Pacific side, the temperature of the latter being lowered by the antarctic current I have mentioned. In consequence, the colder atmosphere of the Pacific coast rushes eastward through the wide glacier-filled valleys of the low Patagonian Cordillera to fill the vacuum created by the heated belt on the eastern slopes of the mountains, and the result is an abundant rainfall among the eastern foothills of the Andes and that long series of lakes which has been shown to us this evening, thirty to forty in number, nearly all of which lie along or near to the 72nd degree of longitude west from Greenwich. These not only collect the storm-waters, but the flow from the glaciers and the melting snows, and, through deep gorges across the tertiary formation of Patagonia, send their surplus waters to the Atlantic. It is a curious fact that, generally, these gorges in Patagonia, from the Rio Negro to the Straits of Magellan, run nearly east and west. If we start from the *massif* of the Andes in Bolivia and move southward, we find that almost all the inter-Andean depressions run nearly north and south until we reach about lat. 34°, and that these have been so terribly eroded in past geologic ages that the valleys are filled to a great depth with shingle, as, no doubt, Dr. Moreno can confirm. These characteristics continue nearly to the northern frontier of Patagonia; but south of this, the depressions change their course, as I have said, to east and west. This seems to indicate that Patagonia was once a vast archipelago, cut by numerous inter-oceanic straits and fiords, filled with great glaciers, which, as they disappeared, denuded the mountains and formed that vast tertiary Patagonian plain which so attracted the attention of Charles Darwin.

It is notable that the continental *divortia aquarum* are not always found in the Cordillera of the Andes, and this is especially true of Patagonia; for the water divide is frequently far east of the mountains and in the middle of the great

Patagonian plain, from which rivers flow westward through the Andean gorges (the straits of the ancient archipelago ?) into the Pacific ocean.

Similar examples, but perhaps not originating from the same cause, are found along the whole extent of the Andean Cordillera. There is an instance in Bolivia: the La Paz river, which I have descended, rises between the main and coast ranges, cuts through the former, and pours north-east into the Beni valley.

In my travels in Ecuador, I found several rivers which rise on the slopes of the inland mountains, cut through the coast range, and empty into the Pacific ocean. The Pastassa river rises on the inter-Andean plateau, and carves its course through the inland range eastward to the river Amazon. The most notable instance is the Guallabamba river, which rises on the slopes of Cayambi and Cotopaxi, those great volcanic cones of the inland Cordillera overlooking the basin of the Amazon. The Guallabamba has, through a vast deposit of volcanic detritus and ash, scored for itself a profound bed, a mighty gorge which I crossed some years ago with great difficulty, and found by barometric measurement to be 2000 feet deep in a distance of only half a mile. The river has sawed westward through the Pacific coast range around the northern base of the volcano of Pichincha and found its way to the Pacific. When Cotopaxi is in eruption, and its melting snows swell the volume of the river, nothing can withstand the grinding force of the rock-and-mud-laden waters, which, in a tremendous wave, race onward to the ocean.

It is too late to say much this evening; but let me add that I am delighted that Dr. Moreno has made the suggestion to send an expedition to Patagonia to make further explorations. It is a field brimful of interest, and destined to become an important province of that young and vigorous country the Argentine Republic, the progress of which so challenges our admiration. Its enlightened Government might well find it a highly profitable venture to supply the necessary funds, and entrust to our Royal Geographical Society the organization and direction of an expedition to complete the work so admirably commenced by Dr. Moreno.

The PRESIDENT: It is now my great pleasure to invite you to pass a vote of thanks to Don Francisco Moreno for his valuable paper. Speaking for myself, and probably for the rest of the meeting, I can say that I have never before learned so much new geography in so short a time. It is many years since we heard anything of this Eastern Cordillera at one of our meetings. I think it is at least thirty-five years ago since Sir Woodbine Parrish communicated a paper from Don Manuel Cox, and though he described Lake Nahuel-Huapi exceedingly well, we could not then have such an idea of its beauties, as we have received from the magnificent photographs of Don Francisco Moreno. I had also heard of Lake Viedma, otherwise the whole of these lakes are entirely new to me. They appear to have been the ends of fiords, exactly like those on the western coast, but we were until this evening in ignorance of their exact positions. We knew, of course, from the descriptions of Charles Darwin, of that great tertiary plain and of its terraces, for I suppose it is now established that the word Patagonia is the same as the Quichua, *Pata*, "a terrace," and *cerna*, the plural particle, meaning "the land of terraces," exactly as Charles Darwin has described them; but we knew nothing of this marvellous country at the foot of the Cordillera, and for this knowledge we are indebted to our friend, Señor Moreno. I don't doubt that the new tracts he has described will in the future become a very important country, that there will be great cattle farms along the eastern Andes, and that there will be large hotels on the shores of Nahuel-Huapi frequented as health resorts, not only by South Americans, but by Europeans. We have always had most friendly relations with the geographers of Buenos Aires and the whole Argentine Republic, and I trust that that friendly feeling will always continue. Science has to thank Don Francisco

Moreno for the establishment of the museum at La Plata, where geographers are instructed, where information on the geography and geology of the country can always be obtained, and which has been visited by Dr. Lydekker, who I regret is unable to be present this evening through illness, as well as by other Englishmen.

You will therefore, I am sure, feel that we owe a very large debt of gratitude to Don Francisco Moreno for all his labours during many years, and more especially for the delightful evening he has given us, and the beautiful views he has shown us. I now ask you to pass a vote of thanks to Dr. Moreno for his paper.

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SKETCH MAP OF SOUTHERN ARGENTINA

from a survey under the direction of

DR FRANCISCO P. MORENO.

Scale of Miles

0 50 100 200

Nat. scale 1:5,000,000 or 78·9 miles = 1 inch.

Heights in feet.

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