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RECENT EXPLORATION IN TIERRA DEL FUEGO.

BY JOHN GUNN,

"Challenger" Expedition Commission.

INTRODUCTORY.—The explorations carried on in Tierra del Fuego by Mr. Popper, C.E., accompanied by Don Julio Carlsson, some skilled assistants, and a body of labourers—making in all a party of eighteen men—and by Mr. Cosmos Sprio and a friend, have done much to widen our knowledge regarding the physical features and natural resources of what is yet, to a great extent, an unknown country. In common with most remote and but partially explored corners of the earth, Tierra del Fuego was credited by the geographers of the sixteenth century with being one of the numerous places inhabited by tailed men; and fables, although scarcely so absurd as that just quoted, continue to be associated with popular notions concerning the island and its inhabitants, despite the visits and partial descriptions of such navigators and naturalists as Cook, Weddell, Fitzroy, Darwin, etc. The confusion of ideas still existing in this connection is well illustrated by Mr. Popper's experiences when endeavouring to ascertain, from sealers and sailors who had visited the island, such information as would be likely to prove of use during his journey. The divergence in the statements of those consulted was truly remarkable; no two agreed as to what was to be seen or might probably be experienced. Some declared that the whole face of the country was covered with impenetrable forests, amid the recesses of which a race of puny, decrepit Indians eked out a miserable and useless life. Others were positive in saying that the whole land was bare of timber, the soil cold and sterile, the scenery monotonous and depressing, and the inhabitants a tribe of giants. Nor were there wanting those who spoke enthusiastically of "the picturesque beauty of the valleys and mountains." No conclusions whatever could be drawn from these and similar statements, but we now know that there was truth in all of them, and that Tierra del Fuego is so diversified in its surface, and so varied in its soil and climate, that a person visiting a single point on its shores is almost sure to have experiences widely differing from those of another who may land at no great distance from the first, and if they push any way into the interior their impressions are still more certain to differ. Such would appear to have been the case with Mr. Popper's informants; they had visited different parts of the country, and spoke of the whole from their experience of comparatively small areas.

PHYSICAL FEATURES.—At the extreme south-west of the island a range of mountains attains, at its highest point, an altitude of 7000 feet; from it two chains run out in, respectively, south and west directions, and at nearly right angles to the principal range. From the neighbourhood of Useless Bay smaller elevations run in parallel courses towards the north-east. The first of these has been named Carmen Sylva in honour of the Queen of Rumania; it crosses the middle of the island, and termi-

nates in the cliffs of Cape Sebastian facing the Atlantic Ocean. The second range rises rapidly in the vicinity of Cape Boqueron, stretches out towards the Straits of Magellan, and gradually merges into the high table-lands between Cape Espiritu Santo and San Sebastian Bay. This range is known as the Sierra Balmaceda, and was crossed by Mr. Popper's party, after experiencing the greatest difficulty in crowning the ridge, on account of the deep snow with which it was covered, the shovels of the explorers being in constant requisition in order to clear a path. This obstacle and others, encountered when descending the southern slope, in the shape of thick timber and almost impenetrable undergrowth, caused five days to be consumed in struggling over six miles. Mr. Sprio, also, bears testimony to the slow progress travellers in Tierra del Fuego must frequently be satisfied with, for it has taken him a month to cover 40 miles, whereas, under favourable circumstances, he was often able to advance at a rate of 20 miles per day.

The rivers examined in these recent surveys are the Juarez Celman, the Carmen Sylva, the Gama, the San Martin, and the Cullen, with two rivulets, named by Mr. Popper the Alpha and Beta. Of these the Juarez Celman is the largest and most important. Rising among the highest hills of the island, its course lies, for the most part, through the great central plain. From the observations made, which, from want of time, can only be considered as approximate, the velocity of its current is 1 mètre 10 centimètres per second, with a width, at 28 kilomètres from the mouth, of 70 mètres at low water, rising at high water to 800 mètres. The water is bright and clear, and had a surface temperature of 8° Cent. in November. It is believed to be navigable for a considerable distance, and, if this be so, the stream should form a commercial highway of great importance when the country is opened up and ready to take advantage of its resources. The direction of its course is towards the south. The Santa Maria flows south-west, its waters are yellow and muddy, and, where crossed by Mr. Popper's party, ran through a deep gorge or cañon, with precipitous sides, the descent of which was not accomplished without difficulty and danger. The Carmen Sylva flows south, the San Martin west, and the Cullen, Alpha, and Beta towards the north.

Between Porvenir Bay and the river Santa Maria the country is undulating, the slopes clothed with thick brushwood, and the hollows damp and marshy. The whole land between Useless and San Sebastian Bays is a dreary monotonous plain, its grey earth not much hid by a scanty growth of yellow, sickly grass; not a tree or bush relieved its expanse, except near the sea or in the vicinity of rivers, where glades, or *canadas*, lent a most refreshing variety to the view. In these spots the verdure was green and fresh, with trees and underwood growing in some profusion. To the north, and also, perhaps, to the south—although the information regarding the country in this direction is rather vague and unsatisfactory—the plain appears to be much more fertile, and promises well for stock-raising. Mr. Sprio met with numerous swamps or “lagoons” in these pampas, which, from their extent and nearness to each other, made the passage through them a work of great difficulty.

GEOLOGY.—There is no want of evidence throughout the island to show that the land is rapidly rising. Lines of cliffs bearing unmistakable traces of wave action at no very remote period occur at several places more or less removed from the present high-water mark—notably near Cape Sunday, where they run far inland, on the borders of the Cullen valley five miles from the sea, and, again, to the south of San Sebastian Bay. Trigonometrical surveys made between Capes Sunday and Peñas proved beyond doubt that since the visit of Captain Fitzroy the coast-line has advanced three kilomètres. On the western shores of San Sebastian Bay the lately dried land has not yet had time to assume a covering of vegetation, and the detritus from the older part of the island, laid down in the sea, now lies exposed, cracked, and desiccated by atmospheric action, but otherwise in much the same condition as when covered by the waters of the ocean. Erratic boulders are exceedingly common all over the country; they are usually of granite, syenite, and gneiss, sometimes traversed by quartz veins, and without a trace of similar rocks *in situ* near them. Although generally confined to the plains, these blocks were frequently found at altitudes of 300 mètres, although at such heights they were considerably decomposed and weathered. That they were carried over the water by icebergs, and let fall in their present position seems clear. *Patellæ* and *Mytili* shells are constantly found associated with them. The higher grounds having been longer exposed than the plains to the action of the elements explains the partially disintegrated condition of the boulders seen on the more elevated portions of the country. They have all a more or less vertical position, which may have been caused by their having had to pass through some depth of water after being dropped by the transporting icebergs and before reaching the bottom. From the configuration of the banks of the rivers which have been surveyed—all having cliffs to the south and gently sloping plains to the north—it would appear that the tendency of elevation is to the south-east.

In a line of cliffs near Cape Espiritu Santo an interesting discovery, in the shape of a bed of lignite, was made by Mr. Popper's party. The dip of this bed closely follows that of the land, rising from a height of 6 feet at its extreme inland point to 120 feet near the sea. In it trunks and branches of carbonised trees are presented, imbedded in a schistose formation; these fossil trees differ entirely from any now seen on the island, their presence indicating a great change in the climate and physical conditions of the region. From measurements made by Don Carlsson the following tabular description of the cliff has been compiled:—

Vegetable Earth, . . .	0·60 mètres.
Gravel, . . .	1·00 "
Sandy Conglomerate, . . .	9·00 "
Sandstone, . . .	3·00 "
Gravel, . . .	6·00 "
Carboniferous Bed, . . .	0·70 "
Sandstone, . . .	4·00 "
Conglomerates, . . .	22·00 "

46·30 mètres.

A number of petrified trees are presented in a cliff 80 feet high on the north shore of Useless Bay. The trunks lie in a horizontal position: they vary from 30 to 40 centimètres in diameter, and have clearly marked concentric circles. Many of them have been turned into a crystallised calcareous spar. Fossil shells, imbedded in an argillaceous rock, are also found in the neighbourhood, which promises an interesting field for exploration by geologists who may in future visit the island.

The curious effects of weathering upon the rocks is especially remarkable in the vicinity of the Beta. Here one solitary pillar has been so carved by atmospheric action as to assume the likeness of a huge human form; it is at first difficult to believe that it is not artificial.

So far as yet discovered, the whole of the rocks of the island appear to belong to the Tertiary Period; they are "large stratified masses associated with sandstone, sometimes laminated, and covered with a layer of from 5 to 20 feet of coarse gravel or pebbles of a rather angular shape." The other rocks, chiefly erratic blocks we suppose, are granitic and felsitic porphyry, diorite, gneiss, granite, serpentine, syenite, trachite, quartz, amphibolite, and petro-silex. Extensive beds of dark blue sand, principally composed of magnetite and small rubies and garnets, are frequently met with.

Gold is as yet the only metal discovered in Tierra del Fuego. Mr. Sprio has found traces of it in all the streams he has examined, and the evidence collected by Mr. Popper points to its very general distribution. It is alluvial, and shows signs of recent formation in the sea bottom. It consists of 90 per cent. of pure gold, 9·5 per cent. of silver, and 0·5 per cent. of other substances. Gold-seeking appears to be the popular occupation on the rivers of the west coast, the people giving themselves almost entirely up to it, to the neglect of other more useful and, could they be brought to see it, more profitable employment. A party working on a Greek speculator in the cañon of the Río Santa Maria informed Mr. Popper that uninterrupted work brought them 30 to 40 grammes per day, which they appeared to consider a fair return for the speculator's capital and their own labour.

FLORA.—The flora of Tierra de Fuego is more varied and luxuriant than might be expected from popular accounts of the island; indeed, the more common plants show little difference in variety and strength of growth from those on the other side of the straits. The northern parts, as might be expected from the more genial climate which prevails there, is the garden of the country, but even to the south there are extensive and spreading plains, covered with a variety of fine grasses, and forming a splendid pasture country fitted to support large herds of cattle. The department of San Sebastian would be especially suited for stock-raising had it a better supply of timber, and this deficiency is all the more to be regretted when it is known that other parts of the island less suited for the operations of the rancher have an abundant covering of wood. In the departments of Buen Suceso and San Sebastian alone there are over two hundred square leagues of good pasture land. Settlers are already beginning to spread themselves towards the south, and

manage to raise remunerative vegetable crops. Pansies, carnations, forget-me-nots, violets, and many other sweet old-fashioned flowers make gay the gardens of the settlers, and are raised without any difficulty. It is to be regretted that so many of the people should spend their time in an almost fruitless search for gold, when so much land awaits those ready to seize the advantages it possesses.

The part of the island lying between Useless Bay, the Atlantic Ocean, and a line drawn through Cape Peñas, supports extensive forests of beech and *Drymis winteri*, among which a fine cypress, *Libocedras tetragonus*, is not uncommon. To the west of Useless Bay, however, the area under timber is not large. The foot and lower slopes of most of the hills are covered with a more or less dense growth of bushes, principally *Berberidæ*, an *Escallonia*, *Ribes magellanica*, an *Embothrium*, *Myrtus mummularia*, and *Berberis axifolia*, the latter being much the most common; indeed, along a large part of the Atlantic shores of the island it is the only bush seen except a few "black bushes," or *Saliceniæ*. Lichens abound on the heights towards the west, as well as on several small arid areas where nothing else appears to be able to thrive. More than half the high ground traversed by Mr. Popper's party was covered with a mixture of grasses, principally *Poa* and *Festuca*; the valleys are full of tussock and *Arrhenaterum avenaceum*. The tussock makes a fair substitute for asparagus, and *Teesdalia* for radish. Wild celery is common.

The undulating ground in the vicinity of the Santa Maria River is covered with *Empetrum rhubrum*, but the bushes are small and stunted; they also occur on the southern slopes of the Sierra Balmaceda, along with some *Myrtus mummularia* and a few *Berberidæ*. Lower down, on the same slope, Mr. Popper passed through what he well names an Antarctic forest. It consisted principally of beech and magnolia growing so close as to make progress through them a work of difficulty. Thousands of uprooted trunks lay in all directions, humid and decomposing. Many of the trees still standing were found to be dried up, rotten, and so light that trunks, even of a couple of feet in diameter, could be easily plucked up by the passing traveller in one hand.

The bark of the magnolia smells and tastes like that of the cinnamon, and may, in the future, prove a valuable commercial commodity.

FAUNA.—For an island situated so close to continental land as is Tierra del Fuego, the fauna must be pronounced poor. There are but five species of quadrupeds, viz., the guanaco (*Auchenia*), the dog (*Canis fucgianus*), the tuco-tuco (*Ctenomys*), a fox, and a small rat. The guanacos are few in number, and are seen in smaller flocks, and are much wilder than in Patagonia. The tuco-tuco, on the contrary, swarms in every direction, and its extraordinary burrowing powers have been used to such an extent on the barren portion of the central plain as to cause the journey across, especially if undertaken on horseback or with baggage animals, to be performed with difficulty, often with danger both to man and beast. Foxes frequent the glades, or where abundant cover may be found. Birds are numerous, most of them being fit for food. The most common species are the *Centrites niger*,

Vanellus cayanus, the *Sturnia funerea*, and the *Chleophaga magellanica*. Ducks, geese, curlews, green plovers, buzzards, and swans are all abundant, and make welcome additions to the supplies of the explorers. Owls, bandurrias, falcons, gulls, etc., were also seen. The *teru-teru*, as the *Vanellus cayanus* is called here, is a most undesirable travelling companion on the plains; the bird follows any moving figures he may see, and by his well-known cry prepares the Indians to receive visitors, which, when strong enough, they do in a far from friendly manner. Their noise, also, scares game, and makes hunting much more difficult than it would otherwise be. Seals and sea-lions appear to be getting scarce, and few are to be seen along the shores.

The Fuegian dog is a great coward, and of little or no use as a hunter. It is, therefore, somewhat difficult to account for the large numbers kept by the Indians at their encampments, but Mr. Popper, judging from an incident which came under his immediate observation, suggests a solution, which is certainly ingenious. His theory is that these animals are taught to cluster and pack themselves tightly round their master and his family when asleep, and thus produce a very necessary degree of heat, where scanty garments of skin and a few branches, by way of a hut, form the only protection against the extreme cold.

METEOROLOGY.—The climate of Tierra del Fuego is one of the stormiest on the whole globe, accounted for partly by the continuous current of cold air which, drawn down from the elevated glaciers and snow-covered mountains of the south-west, whirls eastwards over the pampas until it reaches the coast, where, under the influence of the sun, an ascending column of heated air is generated, and marks the centre of minimum barometric pressure. Another cause of the climatic conditions of the island may be found in the ocean currents flowing from the coast of Brazil and from the Antarctic regions; these meet off the coast, and are supposed to exercise some influence on the west winds which lash that shore. These winds begin, as a rule, to blow at daybreak, increasing in force by noon, and in the evening frequently attain a velocity of forty metres per second. At dusk it becomes calm, and there is no wind for several hours. Winter, when there is only six hours between daybreak and sunset, is the calm season. Then the winds, when they do blow, are generally from the north, and, along with the effects of the Brazilian current, tend to modify the temperature, so that the minimum is seldom under 10° below zero. Mr. Popper carefully noted the results of his observations with both thermometer and barometer, and found that the maximum height of the former was $+23^{\circ}$, and the minimum -6° . The average temperature of the air between the hours of 6 A.M. and 6 P.M. was $+11.5^{\circ}$, and during the night $+2^{\circ}$. The mercury in the thermometer generally stood highest at 10.30 A.M., and fell lowest at 10 P.M. Nothing definite could be deduced from the signs of the barometer; a longer experience of its working in this climate must be obtained before any rules can be laid down for the guidance of observers.

POSITIONS.—Mr. Popper was able to accurately fix the positions of

several points on his line of march, and this must be considered not the least useful of his observations. He satisfied himself that the north shore of Useless Bay really lies three miles further north than is indicated on our charts. The following are the positions of the points fixed by the explorer:—

	Lat.	Long.
North Shore of Useless Bay, .	53° 25' N.	70° 9' W.
San Sebastian Bay, .	53° 15' N.	68° 13' W.
Mouth of the Juarez Celman, .	53° 46' N.	
Mouth of the Carmen Sylva, .	53° 40' N.	
Mouth of the San Martin, .	53° 16' N.	
Mouth of the Cullen, .	52° 53' N.	
Mouth of the Alpha, .	52° 44' N.	
Mouth of the Beta, .	52° 45' N.	
The Three Sphynxes, .	53° 15' N.	

THE INDIANS.—The aboriginal Indians are stout, tall, and strong, some of the men being over six feet in height, and the upper part of the body well-made and developed. Their skin is of a light copper colour, smooth and oily to the touch. A tonsure, produced by the clever manipulation of a hot cinder and rudely made comb, appears on the middle of the head, around which their long black hair falls in dull, heavy locks. The face is generally oval, of orthogonal type, with a narrow brow, prominent and nearly horizontal eyebrows, high cheek-bones, and an almost aquiline nose. The mouth is generally medium-sized, and contains teeth of a yellow colour. The ears are large, pendulous, and altogether badly shaped. The men display a very few hairs, often not more than three, on their chins. The whole character of the head resembles that of the North-American Indian. Their legs are thin, showing little or no calf, and in striking contrast to the strong shoulders, arms, and breast above them. The clothing of both sexes is the same, and consists of a cloak of guanaco skin slung over the shoulders; it is thus difficult to distinguish the men from the women at a little distance, indeed it would be impossible to do so were it not for the burden with which the latter is always loaded on the march, her lord and master contenting himself with carrying his weapons. The men wear a triangular piece of skin on the forehead, seemingly by way of ornament, and some of the married women deck themselves with a few shells of kinds common on the shores. A pouch, or small bag of skin, is carried by the men, containing their food, a bit of dried fungus, a piece of iron pyrites or stone, and a small purse full of a red pigment, probably that used in decorating their faces, for they paint with a lavish if somewhat unskilful hand. Their weapons consist of bows and arrows, spears, and harpoons. Bow-strings are manufactured from the sinews of the guanaco, and the arrows pointed with sharp flints or such bits of broken glass as they can pick up on the shores.

Their dwellings, or rather shelters, are composed of a few branches of trees stuck into the ground, beneath which they crouch without any

attempt to form a roof to protect themselves from the severe rains. Near the sea a tribe was found living in holes which they had dug in the ground, where they appeared to enjoy, for them, a considerable degree of comfort.

These Indians are extremely quick and nimble in their movements, and can cover a surprising amount of ground in a short time. The spaces between the tracks left in the sand by a flying native were measured by Mr. Popper, and found to average 1 mètre 90 centimètres.

They inflict wounds upon themselves—whether from a religious or other motive does not appear—and display little concern when undergoing the operation, although the gashes inflicted are often of rather a serious nature. They can remain without food for a considerable length of time without appearing to suffer any inconvenience. Mr. Popper heard of an instance in point where a girl fasted for nine days, and when, at the end of that time, a sheep was set before her, showed little inclination to eat. At last she fell-to, and when the meal was ended nothing remained of the carcase but the bones, nor did she appear to be at all uncomfortable afterwards. The horses of travellers are never safe from the natives, as they consider horse-flesh one of the greatest delicacies, and prefer it to mutton. On one occasion Mr. Popper's party was so reduced for want of food that they had to kill one of their horses and eat part of it, which they found made a very good dish for hungry men.

The Indians appear to be, upon the whole, a cowardly race, although, when they imagine they are in sufficient numbers, they do not hesitate to attack travellers; but it must be admitted that they are not at all treacherous in any hostile movements they may undertake. Mr. Popper had more than one engagement with parties of hostile Indians, and on the last occasion was compelled to shoot down some of them, an action on his part which appears to have had a most excellent moral effect, as when Mr. Sprio passed over that part of the country some time afterwards, he suffered much less annoyance and interruption from the natives than at any former period. They appear to have a superstitious dread of the mountains, and never venture among them. Travellers, when traversing the higher grounds, have never been annoyed by the natives, who show the greatest disinclination to approach the heights.

PROCEEDINGS OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.

RECENT events in East Central Africa having combined in bringing about a state of affairs which seriously threatens the present position and future prosperity of the Scottish missions and trading companies in the Lakes Region and Shiré Highlands, the Council of the Society has taken up the matter on national grounds, in order to support the work of Dr. Livingstone, who was the first to discover and to open up to European settlement and missionary enterprise the Lakes Region of Central Africa. The whole subject has twice been brought before the Society by the Secretary, Mr. A. Silva White; on the first occasion, at a meeting of the Geographical Club in Edinburgh, on 21st April, and on the second occasion, at