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CANALISATION
OF THE
CENTRAL PAMPA

OF THE
ARGENTINE REPUBLIC
Translated from the Spanish
OF
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Canalisation of the Central Pampa.

INTRODUCTION

This little work is published with a view to a two-fold object.

The first object is to satisfy, as completely as lies in our power, the requirements of the Financial House in London with which the agents of the Undertaking have arranged *ad referendum* the contract for the supply of capital to realise the important work of the Canalisation of the Central Pampa. In order to complete the negotiation and form the Company before holding the Concession, the Financial House naturally requires of us at least the circumstantial plans of the preliminary project, that is to say the main outline of the studies and a detailed estimate of the cost of the work, as well as a calculation of the profits to be yielded from its exploitation; this calculation to be based upon the terms of the Private Bill granting the Concession.

For this purpose, as the reader will perceive, we have considered it incumbent upon us, without sparing pains or sacrifices, to complete the plans of the amplified petition; together with the plans of the longitudinal course of the canal, its locks, dams, dikes, embankment, sluices, reservoirs etc.

etc. (plans N^o. 1. and 2) also the plan of Port Brightman which is to be the Terminus of the canal on the Atlantic, and finally the plan of the general outline of the canal, showing the situation of the public lands which by Art. 24 of the Bill of Concession are granted to the Company in the three National Territories of the Central Pampa, Rio Negro, and Neuquen (plan N^o. 4).

The dimensions of these plans, which exceeded 1.80 metre and 2.30 metres did not admit of their reproduction by lithography on the same scale, and it has been necessary to reduce them by means of the pantograph and the compass to give them the dimensions which they possess in the pamphlet.

Finally in addition to these studies it has been necessary to add all the Historical, Technical and Financial notes which form the body of this work.

The second object of this publication is to facilitate by means of a graphic and illustrated description and compendious report the study of this great project by the two Chambers of Congress, which are called upon to discuss and sanction the Bill of Concession in the course of the next ordinary Session, or possibly even sooner, if the Government should determine to send them a Special Message that the matter should be treated during the Recess. Their discussion will be based upon the draft of the Private Bill already issued by the Committee of Public Works, a draft which with certain modifications in detail, has been already accepted by the Undertaking which we have the honour to represent.

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In this manner we feel sure that the financial labour of the Undertaking will be completed simultaneously with the Bill of Concession, if not sooner; and the preliminary studies for the completion of which a term of twelve months is granted by Art. 6, will be in the main completed and ready to be submitted for the approval of the Government long before the expiration of that time.

These studies not only will supply a proof that the work is easily practicable, a proof which has been required by the Department of Engineers in their second Report (1); but furthermore the matter will thus be presented to the Government with the valuable support and recommendation of English Capital, already engaged and pledged to the profitable fulfilment of this vast work of National progress.

Argentine patriotism cannot fail to feel flattered on receiving certain intelligence of the exceptional welcome which has been accorded in the London market to a project of such a character and such magnitude: for London still continues to be the seat of the financial associations which have most weight in the world and which possess the most complete intelligence, the fullest data with regard

(1) This Report is that which the Department has issued at the request of the Committee of Public Works of the House of Deputies; with regard to some of its indications this Report has served as a base for the terms of the Private Bill which the Reader will find at p. The Promoters although they consider this requirement superfluous, have thought it their duty to comply with the demand of the Parliamentary Committee and to accept the Report.

to the economic conditions of these countries of America.

It is in London that we must look for the boldest as well as the most competent Firms which undertake the construction of canals. It is there that Companies are most easily formed to supply the capital required for these hydraulic works: it is in London that we find the soundest financial judgment in those Banking Syndicates which undertake such matters and are thoroughly competent to understand their cost and comparative profit.

Canals have been made and are being made by all nations. From the remotest ages Asia and Africa have given to Europe the example of the execution of these great works of inland navigation and of irrigation. Europe and the United States, as we have pointed out in our memorial, count them by thousands of kilometres; and British India now exhibits, as we shall describe later, the most stupendous works which modern hydraulic science has attacked and triumphantly accomplished.

But it is not enough to project canals: it is not enough even to prove that they are beyond all question practicable in a given region, in order to induce foreign capitalists to embark upon a project of this magnitude.

Side by side with the technical conclusions, and the proved calculations of cost and profit, it is furthermore necessary that the accomplishment of a project of this kind should be facilitated by the financial and political condition of the country

in which Capital is invited to seek a safe employment and profit.

And with regard to this point, no one will consider it superfluous if we affirm a truth which already has reached the mind and heart of the Argentine People with more or less clearness of scientific perception, namely that the moment has now arrived to give accomplishment to an undertaking of this kind, which had its origin five years ago in the midst of political clouds and financial disasters, which then darkened the horizon of the country. It would be a matter for deep regret should we fail to seize this opportunity.

When, *five years* ago, supported by some competent and clear-sighted men, who entrusted to us the management of this matter, we started upon the labours of this undertaking, there was no one ready to venture a single dollar in studies and projects of this kind, which in fact only roused the laughter of *practical* persons, and the gloomy auguries of those empirics who are only ready to bestir themselves in times of financial inflation, when a harvest of the wildest speculations places itself within the reach of any intelligence.

Notwithstanding this, having some knowledge of the country and of the economic history of the modern world, we never lost faith in the economic resources of the Argentine Republic, in which we lived for twenty years. We have studied and noted the financial state of the country day by day with anxious care; and we never lost faith, as we then declared, even in those melancholy days when all

values came down with a crash, when banks and Government suspended payment, and the country appeared likely to be plunged for many years to come in the dense and universal cloud of a general bankruptcy.

Happily we had some knowledge of the progress of these moral diseases, these intermittent fevers, so to speak, which accompany the growth of young communities still in process of formation, and which as in the plutonic and neptunian periods of the Globe, precede the epochs of condensation and the formation of strata.

Long since did we state our view in some financial articles published in the *Nacion* to controvert some ideas suggested for the solution of the crisis by the Ministry of Finance of that time: this view was that a country which reckons among the inventory of its patrimonial estates the assured possession of sixty thousand square leagues—or six hundred thousand square miles of public land in the Temperate Zone, in the latitudes most suitable for the development of population and superior cultivation, is not a country which can be considered to be in a state of bankruptcy, as Europe believed it to be, and as many of the most enlightened minds of Argentina believed it to be, sunk in consternation as they were before the magnitude of the disaster by that species of panic which settles upon the mind in times of epidemic and crisis.

It will not be amiss to quote from those articles in order that no doubt may remain of the

scientific continuity of our economic ideas, ideas which are based upon a judgment formed and ripened many years ago. It will be seen that they are the same ideas which lead by a scientific channel to the views which predominate in our project of the proposed canal. We transcribe what at that time we wrote, going straight to the point and striving to rise above the atmosphere of dominant empiricism which in these countries of Latin America so frequently settles the co-ordinates of the public Finances.

«It is high time» thus we wrote in 1894 (1) «that this Republic, which justly aspires to the hegemony of Spanish America, should emancipate herself from the financial routine which checks her economic development within the vicious circle of inconvertible paper money.»

«A debt of three hundred millions of paper dollars, which is not fixed in value and is not paid, is a shameful plague-spot in a country which has abused the confidence of the world to such an extent and has fascinated even kings themselves with its public bonds, *yet it is not a crushing load, it is not an evil beyond possibility of remedy* for a country which possesses a hundred most valuable properties within the city itself and in the suburbs of the Municipality, (1) which possesses, roughly speak-

(1) Articles above-mentioned, published in the *Nacion* of Buenos Aires.

(1) In our pamphlet «The defence of the Credit Institutes of the Province of Buenos Aires,» published in the year 1875 we

ing, a million and a half square metres of magnificent property unoccupied in the Port, (2) and which—*according to appendix No. 2 of the MEMORIA EXPOSITIVA of the Ministry of Finance possesses more than FIFTY THREE THOUSAND SQUARE LEAGUES* or five hundred and thirty thousand square miles of public land. (3)

With some of these bricks and a little grey cement or some financial talent, there is more than enough to re-construct in monumental proportions the economic edifice of the country in less than two years: «I mention so long a time only because I am not well acquainted with the qualitative and quantitative analysis of the Cabinet.»

And here it is just to make an observation: although—owing to the international preoccupations which in these last times have absorbed all the attention of our Government—no scientific solution has yet been arrived at for giving a fixed value to paper; nevertheless long before the two years which were suggested in our articles as the limit of time, the unimpeachable administrative morality of the Government of Dr. Uriburu, assisted by the robust vitality of the country, by its unusual in-

give a list on page 157 of these properties, taken from official sources at the time when we served as town-councillor for the parish of the Catedral al Norte; these properties have increased immensely since the districts of Flores and Belgrano have been incorporated with the Municipality of the Capital.

(2) This item of public property, which daily increases in value owing to the completion of the Port-works, does not appear in the calculation of the *Economic Resources* of the country made by Dr. Terry ex-minister of Finance in his laborious *Exposicion Financiera* de la República Argentina (1893) p. 2. and follg. pages.

(3) *Exposicion Financiera* (cited above) p. 104.

crease of productiveness, and by the dawn of international peace which at last has spread its long-desired brightness over the clouded horizon, has raised afresh the credit and the Finances of the Argentine Republic to a greater height than that at which they previously stood, disproving in the eyes of Europe all those sinister prophecies which assigned at least a geological period for the country to heal its wounds and re-conquer its lost credit.

We consider it equally appropriate to remark that the gloomy prophecies of Old Europe—which in judging the financial disturbances of young America, forgets that she too has been young and turbulent—frequently resemble the senile forebodings of old age with regard to youthful temperaments, whose diseases find their own cure without further assistance than the *vis medicatrix naturae* which communicates its vital force to the periosteum, regenerates and restore the bones and electrifies the energies of that functional innervation which leads to the renewal of all the tissues.

Europe also frequently forgets that she is growing old under the ermine mantle of a civilisation which is magnificent indeed, but which does not always hide from the foresight of science the latent convulsions of the threatening problems engendered by the plethora of population and the formidable struggles between capital and labour. She forgets that the inequality of the means of living together with the increase of population and the contagious and fascinating diffusion of economic comfort is hatching in her entrails the equally

threatening problems of modern socialism, which is preparing its vast harvest of levelling influences for the dawn of the twentieth century. Owing to all these causes the day is not far distant when her trembling hands shall scarcely be able to hold the sceptre of the ages without great shocks, whereas America, endowed with vast territories and shadowed by her ancient but virgin forests, is only now beginning to stretch her active and vigorous limbs, full of youth and life in the midst of all the wealth of her gigantic natural surroundings.

It is not a transport of lyrical imagination to affirm with our geographers that our cataracts, such as Niagara, Tenquenduma, Guaira, Nigüil, whose thundering voice can drown the roar of a hundred cannons, are immense reserves of motive power, such as Europe does not possess, for the industrial struggles of the future; that our lakes are seas, some of them almost as large as the Caspian and the jealously watched Black Sea; that our great rivers, the Mississippi, the Amazons, the River Plate, might well disdain as tributaries even the Volga and the Danube; and that the Seine, the Rhone, the Loire, the Po, the Elbe, the Tiber and the Thames would on our far-reaching continent merely wind through the plains as whispering streams; and finally that the Alps, the Pyrenees, the Urals and the Caucasus compared with our colossal Andes and with the snowy heights of Tupungato, (1) Aconcagua, Sorata, Liguá and Chimbo-

(1) Tupungato an extinct volcano 6000 metres above the level of the sea: Aconcagua 6884 metres: Sorata 5184 metres:

razo, would scarcely be visible, like a collection of tents, last vestiges of some encampment of Titans (2).

Even these very financial disasters which have shaken the organism of the Argentine Republic have had the effect of causing its economic possibilities to be better studied and more thoroughly discussed for the sake of those very interests which had been injured. This discussion has been further illustrated by recent statistical figures, which reveal the astonishing productiveness of the country and the steady growth of its revenues year by year: a better-informed and fairer appreciation of the morality of its actual Governments has been reached: and the consequence has been that its credit has risen once more triumphant, as it could not fail to do, and in the great English market there has been a decided return of confidence in the future and in the resources of this rich American sector.—

In the same way the peaceable solution of the international question, due to the practical good sense of the Foreign Offices of Chile and Argentina, which have placed in the hands of the sovereign of the most populous empire in the world (1) the

Liguá 6798 metres: Chimborazo 6530 metres. E. Reclus *Amerique du Sud*, Vol 18. Latzina, *Geography of the Argentine Republic*.

(2) Paragraphs from a letter of the author in reply to a note from the President of the Academy of Artists and Authors of Madrid, Don Gaspar Nuñez de Arce, naming the author Corresponding Member of that Literary Society.

From the *Razon* of Montevideo Feb. 24. 1889.

(1) The British Empire, though it has not the territorial extent of the Russian Empire, is much more populous, since India

friendly arbitration of their arcifineous limits, has contributed in great measure, as we suppose, to naccentuate the lively interest which our undertakig has aroused in London, whose capitalists see with satisfaction that the industries of agriculture and transport in the Argentine Republic are abandoning the hackneyed and usually speculative method of railroad concessions, and are adopting more sagacious and scientific lines.

Hence comes the welcome which we have met in London, and the anxiety with which we are pressed to produce both these studies and also the concession which is soon to convert this ideal of patriotism into a flattering reality.

Many, no doubt, have been the projects which with more or less success have knocked at the doors of the City in search of capital for great schemes of canal construction, in the United Kingdom, in her vast colonial dominions of India and in other countries; but not one, we may say with certainty, which could offer,—as our project offers by way of first compensation to English capital—one thousand five hundred leagues or fifteen thousand square miles of fertile land, upon which can be founded a vast colonial emporium, flanked by majestic and navigable rivers, straightened and canalised by the hydraulic art.

No project can offer to capital and to man's labour a fertile region of virgin soil with an extent of 37,500 square kilometres, that is to say a

alone contains a population of more than two hundred million, subject to the British domination.

country larger than Belgium, which scarcely contains 29,455 square kilometres and supports more than seven million human beings, a country almost half the size of Ireland which only contains 82,240 kilometres and can scarcely sustain its stationary and ill-fed population; a country three times larger than the historic and wealthy principality of Wales.

But our project not only offers mere extent of territory to the capital which is to bring population and productiveness to it, but also offers perfect title-deeds for the property: the land is divided into lots according to the most admired scientific methods, based upon the principles of the Torrens Act of Australia; and the settler is protected by a legislation resembling the Homestead Act which has moulded the greatness of the United States (1) and is now the universal aspiration of France: (2) finally there is the outline traced according to rule, of towns, wharfs and agricultural settlements, all subordinate to a single scientific plan: most of these settlements are to be placed on the banks of canalised rivers, to facilitate regularity and economy of transport, and also by means of a network of small irrigation canals and ditches to facilitate the methodical distribution of water, which, as is well known, is the life-giving element of agriculture, enormously multiplying its possibilities.

(1) Homestead Act Sec. 4. March 20, 1862.

(2) Corniquet: *Le Homestead:—Foyer insaisissable de l'Amille* p. 144.

Proposal of the Deputy Lamire July 18, 1884, and of M. Loreille June 16 of the same year.

We have already foreseen and refuted all the objections concerning these hydraulic questions which empiricism and ignorance might at any time suggest considering the complex variety of matters embraced by our project; objections calculated to throw doubt on its possibility or ultimate accomplishment:—as for instance scarcity of water during the summer in the rivers which it is proposed to canalise, deficiencies in the sources which feed them, exhaustion of the supply owing to losses from evaporation and infiltration. Our memorials and replies have proved that for modern science there is nothing impossible in these constructive works, that no water-course whether it be continuous or even interrupted, can now escape the power of hydro-dynamic force, that any moderately-sized stream can be converted by art into a navigable channel with indescribable facility; and that there are no periodical floods whose devastating inroads cannot be checked and governed by science, either by storing up the water in reservoirs, thence to be distributed by means of irrigation channels and thousands of water-cuts according to an intelligent system for regulating and equalising cultivation, or else by turning the water to useful account for navigation by the simple mechanism of sluices.» (1)

Nay, how can water ever fall short for purposes of navigation and irrigation in a country which—to borrow the happy expression of the

(1) Boletín Geográfico Argentino — Canalización de la Pampa Central vol XVII. Sheet 1. 2. 3. p. 64.

Geographical Institute (2) draws the sources of its river-arteries from the heights and gorges of the Andes, in which region of perpetual snow are to be found the most abundant condensers of the World?

How can such doubts be seriously raised in a country which can look upon the gigantic dyke of San Roque at Cordova already completed and supplying the irrigation of an agricultural district of more than 50,000 hectares? Here there exist a head of water thirty-five metres in height against the upper parapet of the embankment, a superficial extent of water of 1732 hectares, and a volume of 260.000,000 cubic metres of water stored up (1); and all this is formed from the small flow of waters supplied by rivers and stream which are insignificant in comparison with the Atuel, the Chadi-Leuvu and the Rio Colorado. (2)

Such objections as these can only appear as puerile fancies before the experienced and well-instructed judgment of the English market, which by providing capital has contributed to the economic transformation of India; where the sagacity of that market as to colonial affairs has suc-

(2) Volume XVII. Article quoted from the *Direction of the Boletín Geográfico Argentino* p. 12.

(1) Carlos Doynel.—*El dique de San Roque* N.º 3 of the *Biblioteca* p. 392.

Luis A. Huergo. *Canal de Navegación de Cordova al Paraná*. p 89.

(2) The rivers which feed the lake formed by the dyke of San Roque at Córdoba are the Rio Primero, the small river San Roque, and the streams known as Yantí or Mojanas and Santa Maria or Zaucho-Guaico.

ceeded in assuring the subsistence of more than 250 millions of human beings, thanks to the marvellous net-work of canals for navigation and irrigation, which have converted the valleys of the Ganges, the Indus, and almost all the streams of the Gulf of Bengal as well as the deltas of the Godavery, the Cauvery, the Kistna, the Mahanadi and many other rivers, into so many oases of verdure, which yield two and even three harvests in the year; in those very regions where, before the wise dominion of the great English nation undertook these numerous works of construction, failures of the harvests were periodical and as a consequence frightful mortality, twenty or thirty millions of human beings perishing of hunger.

We here have not even the remotest idea of the colossal works which have been realised in her Indian Empire by the portentous daring and pushing genius of England, in addition to the 5,000 kilometres of canals which traverse the United Kingdom in all directions, to say nothing of the last titanic work of the canal from Manchester to Liverpool which has just been inaugurated, and which cost seven millions sterling.

As for the two millions which at the very highest estimate will be the cost of the Canalisation of the Central Pampa and its future colonisation, what is such a sum for a country which has interlaced the immense channels of all the great rivers of India with great canals for navigation and irrigation, such as the Bari-Doab canal of the Upper Ganges, that of Agra, that of Orissa, that

of the Kistna, the Mutka canal, the Ekrush canal and a hundred others—a country which by its creative genius has subdued the capricious and over-flowing torrents of the Himalayas? (1)

Can the financial power of England quail before the idea of constructing the weirs, dams, and reservoirs proposed in our undertaking for the purpose of regulating the course of the rivers of the Pampa, considering that this power without the least effort, in the midst of that orderly British silence which by its successes compels the reflection of the educated world, has constructed dams like that of Myapore on the upper Ganges, which is nearly 757 metres long; that of Novara on the lower Ganges which is 1128 metres long and is composed of forty-two arches of stone masonry, that of Okla which is 743 metres long and has consumed in its construction 130,000 cubic metres of dressed stone-work, that of Dehri on the Soane which is 3825 metres long, is formed of three parallel walls and consumed in its construction 750,000 tons of stone, that of Godavery which is 1600 metres long, that of the Mahanadi, which is divided into three dams, viz. the Naraje dam 110 metres long, the Beropa dam 600 metres, and finally the third and most stupendous of all, the Cuttack dam, 1935 metres long, which cost — the Argentine reader may open his eyes! — the fabulous sum of 300 million

(1) *Annales de Ponts et Chaussées*: 7me. Serie vol 2. 1891. 2nd Semestre. *Compte Rendu*.

frances, that is to say twelve million pounds sterling. (1)

And what is to be said of the number of reservoirs or storage tanks for water to secure a regularity of supply for irrigation, considering that in the Presidency of Madras alone there are no less than 50,000 reservoirs, the walls of which added all together have a total length of more than 50,000 kilometres and include more than 30,000 distinct constructions of masonry? (2)

Do not these figures leave far behind all that the most patriotic imagination could conceive or hope to achieve amongst us?

Do not these facts reveal a humiliating truth, namely that our agriculture in spite of the imposing extent of land, is still in its infancy as regards methods of cultivation and transport?

And in presence of these facts can any-one suppose that English capital will be discouraged by an estimate of little more than two millions sterling for the construction of a canal which not only is to effect a transformation similar to that of India in the central region of the Argentine Republic, but furthermore is to bring about the scientific colonisation of a virgin country, extensive enough to be a kingdom, and a hundred times better adopted than the tropical regions of India for the productions of cereals and meat, which are the two agricultural products most in demand to

(1) *L'Irrigation dans les Indes* par M. Barois. Annales de Ponts et Chaussées:—quoted above—p. 279.

(2) *Idem* p. 280.

supply a consumption which is ever increasing and in fact unlimited?

Unless the English are short-sighted—which they never have been with regard to practical matters of business—unless they fail to perceive that which to-morrow will be descried by the least sanguine patriotism of any Argentine, they must inevitably see the surpassing importance of such a project; they cannot fail to welcome with eager zeal the economic conception contained therein: for without exaggeration it may be said that this is nothing but a transcript of the valley of the Ganges or of the Indus, silhouetted in its virgin luxuriance, with all the outlines of a veritable El Dorado, which is only waiting for capital and labour—in harmonious concert with hydraulic science—to join hands on the sounding banks of the Atuel and of the Rio Colorado in order to dis-inter a future world of riches still undeveloped, in those very regions where twenty years ago the shrill cry of the savage mingled with the fierce roar of the wild-boar and the puma. (1)

The analytical and documentary development of these ideas will be found by the reader in the following pages of this pamphlet, which has been written for a purely financial purpose, without any pretensions to science.

(1) The wild-boar, according to the explorer Dr. Edmund W. Day, abounded as late as the year 1874 throughout nearly the whole valley of the Atuel and in other parts; so also the puma. Olazcoaga: *La Conquista del Desierto*. p. 408 and 409.

However we have no doubt that it will appeal forcibly both to the ears of Argentine patriotism and the sagacious judgment of English capital.

Angel Floro Costa.

Chap I.

Natural conditions for the easy canalisation of the Central Pampa.

The Argentine Republic, whose vast territorial superficies amounts to 2,894,257 square kilometres, (1) and which extends from the twenty-second parallel to latitude 55 1/2 South, thus occupying almost the entire temperate zone of South America, is the region most peculiarly adapted of all the world by its geological, orographical and hydrographical conditions to be the seat of a vast net-work of canals for navigation and irrigation, which will place this country beyond all competition in the universal concourse of agriculture.

In addition to this peculiarity, this country possesses another not less remarkable privilege, which demands our attention as preliminary to the subject which we are about to treat: this privilege lies in the fact that almost the whole of the immense extent of land embraced within the geographical limits of the country, is of exceptional fertility, and suited for every kind of cultivation belonging to the temperate zone; whereas the case is exactly the contrary in the United States, Australia, Canada and other countries which are enabled

(1) Latzina. Geografia de la Republica Argentina. Chapt III. p. 51. E. Reclus Vol. XIX p. 583.

by their geographical position to compete in the markets of the world by offering products similar to those of the Argentine Republic.

In the excellent book of the Argentine plenipotentiary in the United States, Dr. Zeballos entitled *Report presented to this Government with regard to THE CONCURRENCIA UNIVERSAL and agriculture in the two Americas*, published in 1894, this truth is completely proved with regard to the United States and the Argentine Republic.

The proportion of fertile soil possessed by these two nations, computed in square miles of 60 to the degree, is as follows, according to this well-informed author:—fertile area of the United States 2,158,483; fertile area of the Argentine Republic 1,117,400. (1)

Thus it appears that—withstanding the fact that the whole territorial area of the United States is somewhat more than three times greater than that of the Argentine Republic, the territorial area which is fertile and suitable for cultivation is not quite double that of the Argentine Republic. Dr. Zeballos, — whose book written

(1) The territorial area of the United States according to Egisto Rossi (*Concurrenza Americana: Gli Stati Uniti* p. 22) is as follows:—

Including the Peninsula of Alaska (formerly Russian America) 3,602,290 square miles, that is to say, 9,902,149 square kilometres:—

Not including Alaska, 3,025,600 square miles (same page).

According to Señor Zeballos—in his book quoted above p. 467—the total area of the United States is 3,580,805 square miles; which computation, we must suppose, includes Alaska, the territorial extent of which according to Rossi, is 577,390 (p. 22.)

The area of the Argentine Republic according to Latzina and E. Reclus (already quoted) is 2,894,257 square kilometres, and according to Zeballos, 1,117,400 square miles (p. 546): accordingly it will be seen that the territory of the United States

in the United States in the year 1894, bears all the character of an official document, and is abundantly supported by the best-informed authorities, explains this difference by pointing to the immense quantity of arid soil, absolutely unsuited for any kind of cultivation, which is contained in the United States: this class of land reaches a total of not less than 1,422,322 square miles

The State of Texas alone, which according to Rossi has an area of 265,780 square miles, (1) contains according to Zeballos more than 135,000 square miles of arid unpopulated country. With regard to the States of Minnesota, Kansas, Nebraska, Montana, Dakota, Wyoming, Oregon, Washington, New Mexico, Colorado, Nevada and Utah, that distinguished Argentine statesman, and well-known explorer—who personally visited some of those States—declares that the arid character and desolate aspect of this desert on both sides of the Rocky Mountains is indescribable, and the arid land is to be counted by hundreds of thousands of leagues. (2)

As to Australia, whose territorial area is 7,750,000 square kilometres, (3) that is to say somewhat more than double the size of the Argentine Republic, its capacities with regard to climate and fertility fall below those of Argentina.

compared with that of the Argentine Republic is in the proportion of rather more than three to one.

(1) E. Rossi—Gli Stati Uniti, quoted above, p. 22.

(2) Zeballos. op. cit. p. 468.

(3) Gregoire: *Géographie Générale* p. 1128.

« One of the characteristics of Australia », says Gregoire (1) is the insufficiency of water owing to the absence of mountains in the interior and the want of great forests.

Hence it arises that only the Eastern and Southern parts of Australia offer capacities of fertility which can be compared with those of the Argentine Republic. It is in those parts that the principal colonies are situated, namely Queensland, New South Wales, Victoria and South Australia.

According the fact that The United States and Australia both surpass the Argentine Republic in territorial extent is in itself not a sufficient reason why Argentina should fear their agricultural competition in the markets of consumption, since this greater extent of surface is almost balanced by the superiority in climate and in the fertility of the soil.

In the Argentine Republic there are no extremities of heat and cold, such as to cause the thermometer to oscillate, as it does in the United States, between a temperature of 44° Centigrade and 31° below zero; that is to say from the heat of the Senegal to the cold of Siberia, so that the *wheat remains covered with snow during the winter.* (2)

In the Argentine Republic snow is unknown except south of the 38th parallel, that is to say, about the latitude of Bahía Blanca, a flourishing city, the terminus of the Southern Railway of Buenos Aires, (3) and designed to be the great military port of the Ar-

(1) Idem p. 1130.

(2) Zeballos op. cit. p. 478.

(3) Martín de Moussy Vol. 1. p. 364.

gentine Republic: and the extremities of temperature vary—from Salta, which, is situated under the tropic, to Ushia, capital of Tierra del Fuego, not far removed from the Antarctic Polar Circle—between 43° and 27° the maximum temperatures on the one hand, and on the other hand 5° above zero and 10° below zero, the minimum temperatures of winter.

One may then affirm without being suspected of exaggeration that the general climate of the Argentine Republic is the very type of the temperate zone of the planet, where neither the winter is freezingly cold nor the summer scorchingly hot; a climate on the whole milder than that of France, and resembling in its isothermal lines the climate of Southern Europe, of Spain and Italy, (1)

Nature could not have been more prodigal of her favours than she has been towards the Argentine Republic, causing a perpetual spring to reign over her, with the exception of some brief seasons of the year.

A mild and generous climate is one of the primordial conditions, one of those which principally attract population, which always flees from the inclemencies of extreme temperatures.

Accordingly it is with reason that Reclus makes the following remark with regard to Argentina, in his great work on South America:—«From the point of view of Argentine progress, the principal geographical fact is the relative proximity of the country to the European Continent. In spite of all appearances and in spite of the evidence of the map, the streams of the

(1) Eliseo Reclus. Vol. XIX p. 656. Francisco Morens, *viage á la Patagonia Central*, quoted by Reclus.

River Plate are the parts of the South American coasts, which—exercising as they do the greatest attraction over Europe, and summoning her ships and emigrants—are found to be actually and really nearest to the shores of the North: for Europeans naturally and without difficulty direct their course principally to that region of the South American Continent which most harmonizes with the countries of their origin in its latitude, in the average conditions of climate, in vegetation and in manner of life.* (1)

After the climate, the geological, orographical and hydrographical conditions of a country are the matters which decide the future of its population and agriculture: and in this respect we have already said that the Argentine Republic is destined to be the seat of a vast net-work of navigable and irrigating canals, which in the universal concursus of products will place its agricultural wealth above all competition.

With regard to this point also, Argentina has been favoured by nature more than any other region of the Globe. That enlightened writer Dr. Zeballos has exaggerated nothing, in fact he has scarcely expressed the whole truth, when he says in his book that the «Fertile Pampas of Buenos Aires, Santa Fé, Cordoba, the Central Region (Central Pampa, Neuquen and Colorado) (2) and part of Entre Rios (we may add the whole of Entre Rios and Corrientes) are a gift lavished by Nature on the Argentine Republic, to which nothing else

(1) E. Reclus. Vol. XIX. pag. 583.

(2) Zeballos op. cit. p. 475.

(a) The project of canalisation and irrigation proposed by our Undertaking embraces the central part of these territories.

can be compared in the Temperate Zones of the two Americas.

In fact the Argentine Republic on the whole is an inclined plane, sloping from the skirts of the Andes towards the shores of the Atlantic, presenting some interruptions and inequalities, which from time to time break the monotony of the landscape. (1)

At the foot of the Andes, where the great channels begin to be formed of the rivers which descend towards the Atlantic, the heighest elevations of ground scarcely surpass 700 metres, (2) descending thence in gentle slopes across the immeasurable flatness of the regions of the Pampa down to 30 or 20 metres, which is the greatest attitude of the *barrancas* or broken hillocks (*vèrges*) in the neighbourhood of the Estuary or of the Ocean and thence inland for a distance of 1000 or 1500 kilometres.

It is easy to understand that this gentle inclination of the surface of the vast region of the Pampa is one of the favourable conditions upon which the action of the canals can presently be developed: since, as Devauve remarks and as we shall demonstrate below, *fluvial lines of transport are only economical and easy of construction in proportion as*

(1) E. Reclus:—Geographie de L'Amerique du Sud. Vol. XIX. p. 595.

(2) Martin de Moussy vol. I. p. 170.

The city of San Juan stands 704 metres above the level of the sea; that of Mendoza 777 metres: the Desaguadero 440 metres: the confluence of the Atuel and the Chadi Lenuv 130; and so on decreasing down to the lower parts of the River Salado and the mouths of the Colorado. Latzina: Geografia de la República Argentina p. 104.

their fall or slope (pentes) is gentle and imperceptible.
(1)

With regard to the geological formation of the soil of Argentina, nature has been no less beneficent.

The origin, the geological age and the chemical composition of the land of Argentina, have been treated with abundance of observations and studies by men of science of the stamp of Azara, D'Orbigny, Darwin, Bravard, Woodbine Parish, Döring and finally by Martin de Moussy who expounds and re-casts the hypotheses of all these *savants*, in the first volume of his work, the Geographical Description of the Argentine Confederation. (2)

It does not lie within the scope of this pamphlet to treat extensively of these questions and of the various classifications of these lands. It is sufficient for our object to establish clearly the fact that—according to the almost universal opinion of these geologists—the land of Argentina is of terciary formation, and rests upon an extensive bed of red clay, which is covered by a thick layer of vegetable *limus* (*limo Pampeano*) 70 centimetres thick, in fact in some places reaching to a depth of one, two or even three metres: the character of this *limus*, its fossils of the megatherian epoch, its shifting and erratic dunes or sand-hills, its salt plains (*salinas*) indicate an alluvial formation, to which Darwin gives the name of *quaternary* or *Pampean formation*, and which occupies almost all the

(1) A. Devauve:—Manuel de L'Ingenieur. Vol. 6°. Des eaux comme moyen de transport p. 5.

(2) Martin de Moussy. Vol. I. Chapt. III p. 297 and follg.

great plains of the central region of the country, known by the name of *pampas*.

Contrary to that which used to be generally affirmed by some naturalists, the fertility of the Pampa is proverbial.

All the travellers and naturalists who have recently explored these regions, unite in declaring that the Argentine Pampa is the privileged land of gramineous growths.

In these regions two well-recognised kinds of pasture belonging to that family predominate, known in the country by the names of *pasto duro* (hard pasture) and *pasto tierno* (soft pasture): these two growths are almost always found mixed together and covering immense tracts, the former being the food especially of horses and horned cattle, the latter that of sheep: the result is that this exceptional region is an immense meadow for the acclimatisation and development of those animal products which constitute the basis of nitrogenous subsistence for the populations of the civilised world, and also the raw materials of the woven fabrics most in demand.

It is the excellence of these natural conditions of the land of Argentina, which forty years ago induced Martin de Moussy—the most conscientious and indefa-

(1) Martin de Moussy. op. cit. p. 303—313.

D'Onbigny Vol III. Géologie p. 221.

(2) Latzina Geografía de la República Argentina p. 104.

(3) Martin de Moussy op. cit. p. 24. *Pampa* is a native Indian (quichua) word, signifying *plain*. The Pampa presents the appearance of the *Sabanas* of Mexico and North America, and the steppes of Russia and Mongolia. Reclus gives a similar description Vol. XIX. p. 615.

tigable of its explorers—to prophesy the future greatness of this rich country in the following terms:—

«Let the example of the United States supply us with a lesson: let it be considered that immense production has been developed there, upon a soil not so fertile, in a climate not so temperate but under a system of life and management diametrically different. The day that the Argentines seriously desire it; the day that foreign immigration comes to bring to the country the strong arms which are wanting and the agricultural instruction which is lacking to her; on that day, we say, the soil of the Argentine Confederation will astonish the world by the abundance and the quality of its products. » (1)

The brilliant prophecy of the celebrated naturalist is now on the road to a complete accomplishment, simply and solely owing to an intelligent intuition on the part of the Argentine people.

The imposing figures which immigration has reached during the three last decades (2)—at the very moment of writing this pamphlet the immigration in this month of November will exceed 20,000 (3)—the no less astonishing figures which have been reached in these last years by the production and exportation of cereals and wool throughout the whole country; (4) all

(1) Latzina: *Eco de la República Argentina*, p.

(2) *Martin de Moussy* Vol. I. p. 460:

(3) An abstract is here appended of the truly astonishing movement of immigration and emigration in this country during the thirty-eight years from 1857 to 1894 according to the Statistical Annual of Dr. Latzina, corresponding to the last-named year 1894 (p. 500.)

(4) The exportation of live cattle in the year 1894 was

Latzinia: — Immigration and Emigration during the last 38 years: —

Years	Immigration	Emigration	Difference	Nationalities	
1857	4,951		TOTAL BALANCE IN FAVOUR OF IMMIGRATION 1,429,106	Italians	892,992
1858	4,658			Spaniards	256,527
1859	4,935			French	145,785
1860	5,656			English	31,181
1861	6,301			Austrians	26,851
1862	6,716			Swiss	22,380
1863	10,408			Germans	22,477
1864	11,682			Belgians	17,941
1865	13,696			Various	49,643
1866	17,046				
1867	29,234				
1868	37,934			Total.	1,461,777
1869	38,720				
1870	39,967				
1871 (1)	20,933	10,686			
1872	37,037	9,153			
1873	76,332	18,236			
1874	68,277	21,340			
1875	42,036	25,578			
1876 (2)	30,965	13,487			
1877	36,325	18,350			
1878	42,958	14,860			
1879	55,195	22,696			
1880	41,651	20,377			
1881	47,484	22,374			
1882	51,503	8,720			
1883	63,243	9,510			
1884	77,805	14,445			
1885	108,722	14,585			
1886	93,116	13,907			
1887	120,842	13,630			
1888	155,630	16,862			
1889	160,909	40,669			
1890	232,301	82,981			
1891 (3)	52,907	81,932			
1892	73,294	43,853			
1893	86,420	48,794			
1894	80,671	41,399			
	2,058,489	629,383			

We are indebted to the kindness of Dr. Latzina for the latest unpublished statistics of Immigration: Year 1895, 80,988 immgts. 1896 (up to month of November) 107,187.

(1) Yellow fever. (2) Economic crisis. (3) Great Financial Crisis.

this already makes the Argentine Republic the most formidable competitor of the United States and Australia in the markets of Europe, and reveals clearly and distinctly to the educated world the economic possibilities of the country, which are due to the fertility of the soil and the extraordinary mildness of the climate: in fact here we find the co-efficient of that which the country shall be on the day when the spontaneous action of the people is assisted by the intelligent action of the Government, and mere empirical attempts at agricultural colonisation are replaced by a vast system of colonisation and scientific agriculture.

The action and the judgment of man are the only things which require to be modified in our country, in order that they may follow and assist in every way the blessings of nature and the presages of intelligent patriotism.

In this respect we agree entirely with the distinguished Argentine political economist already quoted, who at the end of his learned report sums up the disadvantages under which Argentina labours in comparison with North America, Australia and British India:

according to the *anuario* of Dr. Latzina, as follows;

Asses	Horses	Swine	Sheep	Mules	Horned Cattle
9,423	12,362	7,797	122,218	14,426	222,490

This exportation, we may confidently state, has increased a hundred per cent. during the last two years.

The exportation of frozen meat in the year 1894 amounted to 36,486 tons, for England and France only. During these last two years this exportation has increased in an unusual degree: indeed it is a notorious fact that the three docks of the port of Buenos Aires are no longer sufficiently spacious for the exportation of live cattle, hides, wool, cereals and frozen meats.

among other requirements he especially notes the following:—1. The Technical education of the producer: 2. Cheapness and organised system of transport: 3. The local development of the industries which transform production: 4 The *improvement* of economic materials: 5. Above all the steady protective action of the State working upon equitable plans which conciliate the most lofty interests of Political Economy. (1)

The practical objet proposed in our arduous undertaking corresponds exactly to the second topic mentioned in the above sketch: in fact it is much to be regretted that in Dr. Zeballos' work—which is such a notable treasury of facts and data—there is not to be found a chapter to demonstrate the efficient action which canals for navigation and irrigation, as a means of securing a cheap system of transport, have exercised in the growth and improved development of agricultural wealth, both in the United States and in British India; in the former country the minimum possible freight-charges have thus been forced upon the railways, and the latter country has been converted into a garden of tropical opulence. (2)

(1) Zeballos op. cit. p. 656.

(2) The marvellous net-work of navigable canals in British India—of which we have given a broad outline sketch in the Introduction to this little work—surpassed in the year 1883, according to E. Reclus, 21,000 kilometres in length, without including the extent of navigable rivers and streams which represent a still greater length. Vol 8, p. 600.

England possesses a net-work of canals the longitudinal development of which reaches about 4,500 kilometres.

France has constructed canals to the extent of more than 5000 kilometres without counting a subordinate network of small canals which serve to shorten the distance traversed by petty navigation. The North of Italy also possesses an

Canals for navigation and irrigation are and must continue to be the *sine qua non* of growth and improvement in the progressive agriculture of the Argentine Republic.

As in the United States, canals are the only possible means of arresting the tyranny of freights which presses upon production and commerce through the system of railway communication. Canals will contribute more than anything else to correct the abuses of that improvident bounty which in these young countries of South America has heaped favours upon the first railway undertakings. (1)

The time has come, as Argentine statesmen now understand, to give thanks to the railways for the provisional services which they have undoubtedly rendered to the agricultural, industrial and social development of the country, and on the other hand to begin to extend ample protection to canals, as being the sole works

admirable net-work of canals for navigation and irrigation to the extent of more than 2300 kilometres, the valley of the Po being a model in this respect.

Holland, Belgium and lastly the United States, as we have explained at length in our Memorial, have interlaced their whole territories with an immense net-work of canals, which are the admiration of modern Engineering Science.

(1) With regard to this interesting struggle between the two transport industries, the particular chapter of the recent work of Dr. Zeballos (p. 545.) deserves to be consulted, and also especially the celebrated work of Egisto Rossi «Gli Stati Uniti» (already quoted) chapt. 4, p. 462, where the reader will find the documentary history of canal construction in that country, its fabulous progress, its struggle with the Railway Companies, the rapid fall of freights in consequence and the ample protection which all these Undertakings received from the State in concessions of land, which only up to the year 1884, exceeded 4,500,000 acres of public land-about 2,000,000 hectares.

of irrigation and navigation whose services—beyond all possibility of competition,—will have the effect of reducing the cost of products for exportation and assuring abundance, periodical regularity and wider extension to the harvests.

Accordingly, so far as the geological, orographical and topographical conditions of the central region of Argentina are concerned, as well as the fertility of the land and the temperate character of the climate, these conditions could not be more suitable for the construction of canals for navigation and irrigation; since the gentleness of the slope, and the alluvial formation of the soil are the two initial conditions for the easy and comparatively cheap construction of any canal.

Only in the matter of hydrography Nature has not been so generous to the central region of the Pampa as she has been to other countries, where the accidents of orographical formation accumulate great deposits of water in the subsoil, form subterranean pools, feed the superficial springs and thus give rise to rivers and streams of more or less importance.

Almost all the sources of the rivers which wind in their course over the Argentine plains have their origin in the Cordillera of the Andes, or else in the outlying buttresses or parallel systems of the Andes.

The Pilcomayo, the Bermejo, Juramento or Salado, the Dulce, the San Juan, the Rio Mendoza, the Diamante, the Atuel, the Chadi Leuvu or New Salado, the Colorado, the Rio Negro, and almost all the rivers of Patagonia are derived from this origin.

In the Andes—as we pointed out in our Introduction—are found the inexhaustible natural condensers

which feed these never-failing sources through the periodical thawing of their snow-clad heights.

Forming, roughly speaking, a gigantic *échelon* and leaving vast intervals between them, these streams pour down their water in intermittent bursts, sometimes inundating the plains in the season of floods (*crues*), when the melting snow of the Andes precipitates itself in torrents down the channels, then again flowing with grudging sluggishness during the rest of the year, when the supply is diminished by evaporation, infiltration and bifurcation, and the water becomes distributed into swamps, creeks and pools.

To normalise the course of these impetuous fluvial arteries so as to make use of their waters for navigation and fertilizing irrigation—this is the gigantic but not difficult problem which Nature offers to the activity of civilised man, for whom the science of hydraulics has erased the word *impossible*: since now-a-days there exists nothing which her machines, her mathematical methods, and her mechanical calculations cannot subdue and transform into docility with the help of capital and credit.

Then at last the proverbial fertility of the Argentine pampas, which are now exposed to all the meteorological caprices of the atmosphere and the seasons, shall cease to be a cycle of uncertainties, to enter under the regular classifications of scientific prediction.

« The Argentine Republic, » says Reclus, « does not possess in the neighbourhood of the coast the humidity necessary for its cultivation. In Buenos Aires the memory still continues of the long drought of the years 1827 to 1831, known by the name of *gran seca* (great drought.) During those three years scarcely did

a few passing showers fall in the rural districts. The pastures were changed into a desert: the wild beasts, mixed with the domestic animals, wandered together in search of water and pasture, perishing in the same hollows. In the Provinces of the Interior the droughts last even longer than on the coast; but in those provinces man does not reckon upon the rains of heaven, for there the harvests depend upon the snows of the mountains, which feed the rivers of irrigation. » (1)

The want of abundant forest in the Argentine plains is one of the causes which—together with the absence of orographical and topographical accidentation of the soil—concur in maintaining this scarcity of humidity noticed by Reclus, and the irregularity of fertilizing rains, which has for so long a time principally occupied the attention of clear-sighted writers on agriculture in this country.

It is well-known that forests regulate the course of rains, diminish the ravages of epizootic disease, improve the condition of rural industries, and lastly extinguish the plagues of locusts and other no less destructive *orthopterae*.

A notable Argentine writer, a member of the medical profession, who has made a special study of forests and their climatic influence on Argentine soil, writes thus:—“*That which takes place on our Pampas—between*

(1) E. Reclus: *Géographie de L’Amérique du Sud* p. 6551 Reclus in this part of his work quotes a very noticeable article published in the *Revue des Deux Mondes* of April 13 1877 by M. Emilio Daireaux, a Frenchman resident in Buenos Aires for more than 40 years. We ourselves during our long sojourn in Buenos Aires have witnessed other droughts not less disastrous for agriculture and for the life and increase of cattle.

drought and inundation—is extremely lamentable. In the years when our industrial producers (I speak of the cattle industry) do not complain of want of pasture owing to the want of rain, they complain of the excess of water: nor does even this remedy the want of water; for it frequently happens that at a certain time in the year the rains threaten an inundation, while two or three months later the buckets are being prepared to draw the water to be drunk by the poor animals which are so serviceable to man and usually so ill repaid by him. (1)

Not only does the absence of forest in most of the Pampa region of the country affect the droughts and inundations; but in addition, the improvident timber-cutting which goes on, will end by completely altering the conditions of climate. Dr. Piñero in his interesting pamphlet gives us numerous historical examples of this process; and we are already begin to feel it among ourselves: for—besides the improvident character of our legislation—the laws themselves are never observed by those who seek profit by cutting the timber, which is believed by popular ignorance to be inexhaustible.

According to Dr. Piñero, most of the epizootic diseases which cause such mortality among the sheep—through the *distoma hepaticum*, a parasite which has received especial study from the learned naturalist Dr. Berg—are caused by the frequent inundations following long periods of drought.

The last-named writer quotes from the lips of *estancieros* (stock-farmers) the saying, «We are always liable to lose in one year the labour of many,» a say-

(1) Dr. J. D. Piñero. Influencia climaterica de la vegetacion. 1880: p. 19.

ing which both in our country and in Argentina we have constantly heard repeated like a biblical verse representing that fatalism in which the inhabitant of our rural districts resignedly lives pursuing his routine of empiricism: and the estimate of these losses which Dr. Piñero enumerates in his valuable pamphlet, are nothing but the prelude to the many losses which the country has suffered since 1878, and which she must continue to suffer until an intelligent system of agriculture transforms the conditions of the soil. (1)

Accordingly, to modify the conditions of Argentine hygrometry, to assure the normal and profitable use of its scanty hydrographical wealth by a system of irrigating ditches which shall guarantee regularity and abundance in the harvests; moreover not to neglect the re-plantation of woods throughout the whole country:—such ought to be from to-day onwards the fruitful task of the Governments and intelligent statesmen of this country, in order to effect the ten-fold increase of its production and of the Public Revenue in a few years, and make the Argentine Republic the richest, most populous and most powerful Nation of South

(1) Law of Oct. 8, 1880. Regulations of April 16. 1879 Piñero op. cit. p. 30.

Here follow the losses from epizootic disease from 1857 to 1878, as enumerated by this writer:—

Year 1851	6,000,000	dollars	gold
» 1857	7,000,000	»	»
» 1859	5,000,000	»	»
» 1861 to 65	15,000,000	»	»
» 1867 to 69	14,000,000	»	»
» 1874	13,000,000	»	»
» 1877 to 78	10,000,000	»	»

Which makes a total of 70 million gold dollars lost in a period of twenty eight years—A sum more than sufficient to canalise half the Republic.

America. The great Undertaking which we have the honour to represent, and which proposes to canalise the Central Region of the Pampa and extend over its wide plains a vast system of scientific irrigation which shall assure the future of its progressive agriculture for ever:—this Undertaking, we repeat, aims at these patriotic ends more closely than any other which has yet been presented to the consideration of the Government.

But it is time for us to leave on one side the general considerations which we have put forward so far with regard to the Argentine soil and climate, in order to devote ourselves to the study of the project which we have in hand: this shall be the subject of the following chapter.

Chapter II

THE GREAT CENTRAL PAMPA CANAL

It is enough to glance at the general map of the Argentine Republic, in order to grasp a principal fact, which strikes even the bluntest intelligence.

Nature has been as grudging of water to the Argentine Republic, as it was possible for her to be. There is but one river or fluvial artery between the Rio Colorado and the Rio Quinto, which last river springs from the mountains of San Luis and loses itself in the swamps and pools of Juncal, its waters sometimes reaching the small lakes of Mar Chiquita, Chañar and Laguna de Gomez, which give rise to the Rio Salado of the Province of Buenos Aires. Between these two streams there exists no other river or fluvial artery of any importance except the River Chadi-Leuvu, which also bears the name of Rio Salado and of Desaguadero when it descends from the Province of San Luis: this river after traversing with its solitary and sometimes majestic stream all the central region of the country, pours its waters into the great lakes of Urre-Lauquen, whence it seeks a humble outlet towards the Rio Colorado by the little stream of Curacó.

Thus, in examining the map of the Argentine Re-

public, it may be remarked that the central and most extensive part of the country, the part which is the richest and is on the way to become the most populous, has only received from the bounty of nature a parsimonious supply of water in the midst of the profuse distribution which has been received by the great river-basins of the rest of the South American Continent.

As we pointed out in our Memorial to the Argentine Congress, this anomaly, produced by the geological and orographical formation of the Argentine soil, as roughly sketched in the preceding Chapter, presents many points of resemblance to the Eastern region of Africa, known by the name of the Valley of the Nile, which lies enclosed (*encaissée*) between the Arabian Chain, running along the Red Sea and Indian Ocean on the East, and the Lybian chain to the West.

Both these regions are of tertiary formation, and both alike receive their fertility from the central hydrographical system which traverses them throughout their whole extent and which exclusively dominates the vast basins comprised respectively in these two regions. »

« The sole difference », we then said, « consists in the fact that the hydrographical system of the Argentine Pampa is not enclosed, like the Nile Valley, between two chains of lateral mountains, but between the Andine chain and the extensive plains of the Pampa, which stretch in gentle declivities down to the very margin of the estuary and of the Ocean. »

« Just as the Nile is formed from the sources which come down from the mountains of Abyssinia and give rise to the Blue Nile, and from the sources in the

Mountains of the Moon which give rise to the White Nile, pouring their waters into the region of the great lakes (Victoria Nyanza, Tanganyika, Albert Nyanza) so also the great artery of the Chadi Leuvu, (1) which is a continuation of the Rio Salado, is augmented by its affluents, the Tunuyan, the Diamante and the Atuel whose sources are fed in the same heights of the Andes» (2)

And we finished the chapter thus:

« Accordingly Nature in both these hydrographical systems indicates to man the mode of turning these waters to account, not only by utilizing them for navigation, but also by storing up the surplus water which is carried down in the great periodical floods, and so applying it with the aid of hydraulic art to the irrigation of the riparian lands. » (3)

Yet we at the setting of the Nineteenth Century are but just beginning to understand and appreciate that which five thousand years ago was understood and accomplished by the Egyptians; whose plains (as Mat-tebrun (4) says), would never have become the seat of unfailling fertility but for the river-floods which while irrigating the land cover it at the same time with fertilizing mud; and the waters of the Nile are distributed and regulated by means of more than six thousand small artificial canals. (5)

(1) Martin de Moussy Vol. 1. p. 163.

Latzina *Geografia de la República Argentina*, p. 57.

(2) *Ibidem*.

(3) Memorial and statement of the *expediente*—Canalisation of the Central Pampa—now pending before Congress.

(4) Maltebrun:—*Geog. Universelle*. Vol. 6 pag. 14

(5) To-day the Delta of the Nile has a magnificent system of irrigation, due to the great dam constructed near Cairo, at

In a country so admirably suited by Nature for canal construction, it is astonishing that so few progressive attempts have been made to canalise the rivers, and utilize the waters for irrigation.

With the exception of the San Roque reservoir in Cordoba, of the works carried out on the river Mendoza by the engineer Cepalleti, (1) and of the primitive irrigation works which utilize the waters of the rivers San Juan and Mendoza in the two provinces of those names:—with these exceptions we only know of two projects of importance which have called for the attention of the Government.

The first is the proposal of the enlightened engineer Don Luis A. Huergo to construct a navigable canal 453 kilometres long between the city of Cordoba and the Paraná (2): the second is the project of the no less enlightened engineer Don Emilio Mitre y Vedia, to construct a lateral canal to the Rio de la Plata in order to place the Paraná de Las Palmas in direct communication with the Northern Basin of the Port of Buenos Aires, with a total length of somewhat more than 110 kilometres.

the apex of the Delta, by a French engineer during the reign of Mehemed Ali. The surface irrigated is 100,000 hectares. Laguna. Aguas y Riegos pag. 144.

(1) The dyke of the Sanjon Canal in Mendoza is an important work, being well constructed (as we are informed) and supplying water sufficient to irrigate nearly 40,000 hectares.

(2) Luis A. Huergo. Navigation Canal from Córdoba to the Río Paraná. 1890. Official Publication.

(3) Emilio Mitre y Vedia. Navegacion entre el Puerto de Buenos Aires y el Paraná de las Palmas, 1893.

Both these projects considering the amplitude of their conception, the abundance of facts and calculations on which their execution rests, and the depth of economic insight which has inspired them - are to be reckoned, in our opinion, above all encomium: and although in the project of Señor Mitre y Vedia we have noted some incompleteness in the details as to the estimated cost of the work, still we doubt not that both these projects will reach a magnificent accomplishment in days not far distant, according as the country and the Government learn to understand the immense utility of works of this kind.

It is no doubt this peculiarity of the soil of Argentina which induced almost all its famous explorers and also some of its wisest rulers to advise the construction of canals for navigation and irrigation, at a time when rail-roads were as yet unknown.

The first explorer of this part of America who perceived the future importance of canalising the central part of the country then known as the Vice-royalty (Virreynato) of Buenos Aires, was the learned Spanish naturalist, Don Feliz Azara, (1) who travelled for twenty years in the basin of the River Plate; we owe to him the first indications with regard to this subject.

In the report (already quoted in our Memorial) which this *savant* addressed to the King of Spain at the end of the last century, with regard to the proposal of the Viceroy of Buenos Aires to found a town at the confluence of the rivers Diamante and Atuel, he expresses himself in these terms:—

« The Junta approves the foundation of the

(1) Feliz de Azara, Historia del Paraguay: Prólogo p. 5.

said town at the union of these rivers; for they perceive that in addition to the advantages which the Viceroy sets forth thereupon—namely that the limits and frontiers of Mendoza would thus be advanced forty leagues towards the south, and that this point precisely is the passage whereby the nations of disloyal Indians of the skirts of the Cordilleras come to desolate the *campaña* of Buenos Aires—furthermore we may look for other advantages of much importance, although the Viceroy does not mention them: for according to information received by the Junta, the said river Diamante carries water sufficient to be navigable at any rate in light boats from its incorporation with the Atuel down to its junction with the Rio Negro, and this last river again is navigable from that point down to the sea on the Patagonian coast.» (1)

Azara evidently had the embryonic conception of this canalisation, but clearly he possessed a very imperfect knowledge of the hydrography of the Central Pampa, since he confounds the course of the Diamante with that of the Rio Salado or Chadi Leuvu, which receives the waters of the former, and he also appears to be ignorant of the existence of the Rio Colorado, and supposes the Atuel to flow into the Rio Negro.

Possibly Azara never heard that between the Rio Negro and the rivers Diamante, Atuel and Chadi Leuvu is interposed the Rio Colorado, into which these rivers pour their waters. Azara mentions (2) the expedition of Villorino to the Rio Negro, but perhaps was not aware

(1) Feliz de Azara: *Memorias*. Published by Sanchez Madrid 1847. Vol. II. p. 91.

(2) *Ibidem*.

that Villorino explored the Rio Colorado, penetrating a short distance beyond Choique Mahuida, in the year 1781, shortly before he travelled up the Rio Negro up to its affluents from the Cordillera. (1)

In any case we have considered it an act of justice—which has also received the approval of the Parliamentary Committee (2)—to honour with the name of Azara the town which is to be the northern terminus of the canal, by way of homage to the great Spanish Geographer, who was the first to foresee the advantage of opening up to navigation this vast region of the Pampa.

Next after the glimmering perceptions of Azara we come to Rivadavia: no doubt he had taken note of the economic importance which canal construction was now assuming in Europe; for in his genial mind rises the idea of the Andes Canal, which was to start from the river Jachal and thence follow the valleys of the rivers San Juan, Desagüadero, Rio Quinto, Rio Cuarto, Rio Tercero down to the Paraná.

But this proposal—of which the studies, if we are not mis-informed, were never authorised by the Congress of the year 1826—was entirely impracticable owing to the higher levels of the mountains of San Luis as compared with its starting-point; as Señor Huergo (3) technically proves in his erudite study upon Argentine Canals. (4)

Thus the project was merely a brilliant Utopian scheme, born of the foresighted genius of that great

(1) Martin de Moussy. Vol. p. 164.

(2) Bill to grant Concession Art. 3.

(3) Luis Huergo op. cit. p. 75.

(4) Idem p. 77.

statesman, whose ardent and patriotic imagination did not see the obstacles. Had he known those obstacles, he would have been led to modify his plan, without desisting from his grand idea of linking the Provinces of the Interior with the coast, thus cementing sixty years ago the economic unity of the Argentine nation and forming an adamant base for the arduous work of political unification.

After the more or less radiant visions of Azara and Rivadavia we come to the famous explorer Martin de Moussy, who was the first to reach a clear and scientific conception of the importance of canalising these rivers and of their future greatness.

After studying the course of the Atuel, Chadi Leuvu and Rio Colorado, their volume of water, the gradation of their fall, and their hydrographical inter-connexion, this far-sighted precursor of our great Undertaking thus expresses himself.

« It will be by no means impossible one day—when the population has increased ten-fold—to canalise these streams, whose fertilizing liquid now loses itself uselessly in the desert, and so create an immense inland navigation, which will bring the Andine regions into communication with the Atlantic Ocean: San Juan and Mendoza would then possess an economical and sure means of communication for their products, which at present are obliged to roll for three months across the Pampas in heavy waggons, (1) which scarcely do an average of five leagues a day. As for the railroads which will assuredly be constructed in these regions, it is certain

(1) Martin de Moussy wrote this in the year 1860, when locomotion by means of carts was still flourishing.

that they cannot entirely replace canals owing to the moderate cost of transport (1) » The prophecy of this eminent naturalist is now on the road to becoming a flattering reality,* thanks to the clear-sighted efforts of our enterprise, which has spared no sacrifices in studying its practicability and transcendent importance.

Another explorer of these rivers, who in the quality of secretary accompanied the distinguished General Roca in his famous Conquest of the Desert in the year 1879, (2) namely Colonel Don Manuel Olazcoaga, at every step in the pages of his diary of the expedition prognosticates the future canalisation and profitable use of the waters of these rivers, especially the Rio Colorado; while at the same time he dissipates the ancient errors which used to pass for geographical axioms with regard to the desolation and aridity of their basins.

The diary of Colonel Olazcoaga is a remarkable official document, written subject to the testimony of an entire army, whose brilliant group of officers occupy to-day high public positions in the country.

Thus it may be regarded as unimpeachable testimony, as a *pièce de conviction*.

Well, in speaking of the Rio Colorado, the enlightened secretary of General Roca in several passages speaks as follows:—

« As far as the eye can see, the country is very different indeed from that which our *masters* of geology have painted it. There is no *redness* whatever, which

(1) Martin de Moussy Vol I. p. 165.

(2) La Conquista del Desierto:— a topographical study of the Pampa and the Rio Negro, by Manuel Olazcoaga, Lieutenant Colonel, Chief of the Office of Topography and of the Military Engineers: 2nd Edition, 1881.

is the colour in perspective of sandy tracts and arid lands.»

« At all events, this is a living land, which promises to support any kind of cultivation: it is not the skeleton which has been described to us as a kind of Arabian desert. (1) The Colorado is a great River, but it resembles one of those immense fortunes, which must be distributed among many creditors. It has water sufficient for navigation by brigs, but it has also another mission, that of irrigating 8000 leagues of land which in the future will constitute the centre of Argentine greatness. »

Lastly another of the leading intellects which have devoted themselves to the study of Argentine canals, the Engineer Huergo, whose authority is indisputable, speaks even with enthusiasm of the possibility and facility of canalising these regions.

« A rapid glance » he says « at the map of the Argentine Republic—having consideration to the few heights mentioned—will convince anyone that if at any date a navigable canal were to be made providing for the provinces of San Juan and Mendoza an outlet to ports on the sea, there is no other line from the neighbourhood of the Laguna Bebedero, except the valleys of the New Salado, Chadi Leuvu and Rio Colorado, either to the mouth of the last-named or else to the port of Bahia Blanca: to feed this canal the flushes of water which descend from the Andes can be utilized, as well as the permanent streams, following the gentle

(1) *Terres Mandiles* is the term applied by Reclus to these regions Vol XIX p. 655. His description probably does not rest upon trustworthy testimony.

and natural slope marked out by the rivers themselves, without the necessity of great constructive works—with a comparatively small number of locks and with the least possible length.» (1)

Almost at the same time that the distinguished engineer Huergo was writing these concluding pages, which are the anticipatory scientific sanction of the Canal proposed—with slight modification by our enterprise; meantime our preliminary studies were being completed after three years of arduous labour on the spot under the direction of the Chief Engineer of the Undertaking, Señor Don Enrique Romanini.

We may then well affirm that the technical idea which dominates the work has had for its precursors learned geographers and famous explorers, eminent statesmen and engineers of note, who enjoy an incontestable authority in our country, especially in hydraulic matters.

Finally, before treading the threshold of the Argentine Congress, our Project was to receive the last word of encouragement from the Office of Public Works (now Department of Engineers) which after studying our Memorial, the preliminary studies which accompany it, and the bases of the project, thought fit to express themselves as follows:—

« The works proposed by Messrs Angel Floro Costa and C.^o—considering the vast zone which they will benefit by reclaiming swampy lands so as to admit of their settlement, together with the irrigation which will offer to the settlers agricultural enterprise on a great

(1) Huergo op. cit. p. 78.

scale, besides the navigation which will facilitate the cheap transport of their products to a sea-port—are in fact a conception of grand importance, and, should they bear fruit, the Nation will reap from their accomplishment notable politico-economic advantages.

The National Office of Lands and Colonies uses very similar language—too long to quote—in giving its decision in favour of the Concession.

It was then under many flattering auspices that our great project was examined by the Committee of Public Works of the Argentine Congress, presided over by the experienced engineer Don Alfredo Demarchi: and after many conferences with the representative and the engineers of the Project in which the demands of the Government and the interests of the state and of the projectors were thoroughly discussed, finally the Bill of Concession was drafted, which will enter upon the order of the day as soon as Congress re-opens its ordinary session in May next; unless the matter is previously referred to them during the Recess. All this is set forth in the translation, given in the following chapter, of the Report issued by the said Committee.

Chapter III

Report of the Committee of Public Works.

NATIONAL CONGRESS

HOUSE OF DEPUTIES

ORDER OF THE DAY N.º 40.

SUMMARY.—I. Canalisation of the rivers Dlamante, Atuel, C. adi-Leuvu and Colorado (Proposal of Angel Floro Costa and Co.)

Committee of Public Works N.º 1

To the Honourable Chamber of Deputies:—

The Committee of Public Works has studied the project presented by Messrs. Angel Floro Costa and Co. as to canalisation of the rivers Atuel, Chadi Leuvu and Colorado from the bend which the Atuel forms opposite to the city of San Rafael (Province of Mendoza) known as the *Paso de los Chañares* down to the Atlantic Ocean: and for the reasons which the informing member will give, the Committee advises the House as follows:—

PROPOSED BILL.

The Senate and House of Deputies, etc.

Art. 1. The right is conceded to Messrs. Angel Floro Costa and Co. to unite by means of works of artificial canalisation the rivers Atuel, Chadi-Leuvu and Colorado, from the bend which the Atuel forms opposite to the city of San Rafael (Province of Mendoza) known as the Paso de los Chañares down to the Atlantic Ocean, suppressing the breaks of continuity which at present interrupt the extensive course of these fluvial arteries, so that they may form a single canal or fluvial water-way to the Ocean.

Art. 2. The right is also granted to them to join by means of a short railway the town of San Rafael with the town or city which is to be the terminus of the proposed canal: this line shall be of normal gauge and of electric traction, and shall pass by the « Rama Caída » and the « Cuadro García », without prejudice to any modifications of plan imposed by the definitive studies: they shall also have the privilege of prolonging the canal to San Rafael, whenever the proprietors of both banks of the Diamante shall demand it.

Art. 3. At the starting-point of the canal, known as the « Paso de los Chañares—henceforth to be named « Azara »,—the Company shall construct a great dam in the River Atuel, and also the above-named town or city, to be the Northern terminus of the canal: the expropriation of the necessary lands may be made in the form stated in Article 28.

Art. 4. The Company shall also have the privilege of utilizing during the whole time of the concession the

power generated by the water-fall or cascade of Niguil, with the object of converting it into force for electric traction to be applied to the proposed railway between Azara and San Rafael: the surplus force may be utilized for the wharfs of the said port and of the port « Primera Angostura », the Company's work-shops, private smithies etc.

Art. 5. The Company shall also have the right to expropriate the lands required for the construction of this railway branch—its stations, stores, workshops and other installations, as also for the installation of the work-shops at the Niguil Water-fall—in case these should not be public lands: also the right to carry across the country the electric conductors, whose power shall be from 25,000 to 30,000 volts: these shall be installed according to the most perfect systems of isolation.

Art. 6. The Company shall present within twelve months from the promulgation of the Act of Concession—of which formal notice will be issued to the Concessionaries,—an outline plan or preliminary project, drawn up with the intervention of one or more Government engineers named by the Executive, this plan to contain the following *data*:—longitudinal and transversal lines of the canal and of the works to be executed, volume of waters which feed it, loss of water from evaporation and infiltration; locks and storage-system, geological character of the land, extent to be irrigated, quantity of water to be employed in irrigation, and number of times that it will be effected.

Art. 7. If the preliminary studies show that the work is practicable, the definitive studies shall be pre-

sented, with the intervention of the same Government Engineers or others designated by the Executive, within the term of twelve months, reckoning from the day on which the approval by the Government of the preliminary studies is communicated is writing to the Company: and if it appears from said studies that the water of the above-mentioned rivers is insufficient for the objects of the Concession, then the Company shall within the same limit of time propose to the Government the modifications to be introduced into the works projected.

Art. 8. The normal width of the bottom of the canal shall be not less than 25 metres and it must reach 60 metres at the ports and wharfs: and the minimum depth even in the shallowest places shall be 1.50 metres.

Art. 9. The medium velocity of the water shall never be greater than 1.50 metres per second: in case it be greater, its flow shall be moderated and regulated by means of locks, which shall be constructed in such numbers as shall be indispensable in order to normalise the course of the canal, without prejudice to the flood-gates, dykes, dams and reservoirs which are to supply the system of irrigation which the Company may adopt for the lands to be colonised.

Art. 10. Navigation shall be carried on by means of flat boats and steamers of little draught, according to the latest models used on the rivers of the United States: the Company shall present the plans of these with the definitive studies.

Art. 11. The system of traction to be employed on the canal shall be that which is found most suit-

able: if horses be used for towing, a path at least one metre wide must be left on each side of the canal throughout its entire length: all works constructed on the banks of the canal whether by the Company or by individuals must be made subject to the regulation.

Art. 12. The Company shall construct in suitable spots approaches to the water of the canal for cattle, or else shall construct watering-places at convenient distances for the same object.

Art. 13. The Company shall begin the execution of the work and the circuit-measurement of the lands of the Concession within twelve months of the approval of the definitive studies by the Government, and shall complete them within six years from the commencement of the works, except in case of *force majeure* or other sufficient cause which may hinder their construction.

Art. 14. In case of war or for matters concerning the public service, the Company shall place its means of transport at the service of the State, the remuneration for such services being settled with the State.

Art. 15. Also the State shall have power to construct any military works of defence which it may consider necessary at those points on the canal which it may judge most strategically suitable—without prejudice to the fluvial traffic of the Company and subject to the compensation to be arranged between the two parties when such works cause material damage to the Company.

Art. 16. The Company is bound to assign to settlement for tillage or stock-raising all the lands which it receives from this concession, presenting together

with the definitive studies of the canal an uniform study of the plan of settlements which it shall adopt and of the systems which are to fertilize these settlements—subject to the settlement Act of October 19, 1879.

Art. 17. All these lands shall be sold or let to settlers or to colonising corporations in rectangular lots, (according to the law of settlement) duly numbered and having a system of titles arranged, as far as possible, on the principles of the Torrens system, established in Australia; subject to inscription and registration of the lots in the great registration book of the Company, from which can be issued gratuitously the duplicates required by the Revenue Offices under the inspection of the functionary appointed by the Government.

Art. 18. Every title-deed shall be written on parchment. When the sale includes one or more sections, it shall be written on paper of incombustible asbestos, with the addition of a photographic and topographical reproduction of the plan of the lots sold.

Art. 19. The dismemberments which the territory may undergo must also be recorded in the great registration book, as well as all changes of ownership in real estate situated within the limits of the Concession.

Art. 20. Transfer of said properties may be made by simple endorsement, which shall be recorded in the registration book of the Company and noted on the title-deed by the official in charge of the sectional register.

The duties paid on title-deeds, on copies and drawings, on inscription and register of transfers shall in no case exceed six per mil of the actual value of the property.

The public functionary appointed by the Government shall keep a register in official form of the signatures of the proprietors and their *ayants-causes*, also of all powers of attorney and documents which authorise transfer of property.

Art. 21. The Executive Government in agreement with the Company shall regulate the alterations of title-deeds and transfer of property, fixing also the taxes which in these transactions shall belong to the State.

Art. 22. In addition to the cases of exemption specified by the law of executive justice, no embargo shall be laid upon the dwelling-house of the settler and his family during his life, his widow's life and the minority of his children: this shall also apply to a portion of adjoining land not exceeding ten hectares. The furniture for indispensable use contained therein and the tools belonging to the trade or profession of the settler are equally exempted.

Art. 23. The Company is bound to provide boats or floats for the transport of cargo and passengers in proportion to the development attained by commerce in all the region of the canal.

Art. 24. In compensation for the capital and moneys expended in the construction of these works of canalisation—which shall be at least £1,000,000 or five million forty thousand dollars gold—the Nation shall grant to the Company two thousand leagues of public land, of which one thousand five hundred shall be the property of the Company, and five hundred leagues are reserved by the Government within the boundaries of the Concession: the situation of these shall alternate with lands of the Company, so that in every case there

shall be placed together three lots belonging to the Company and one lot belonging to the State.

Art. 25. All these arrangements of situation shall be made with the intervention of the Government engineer representing the Executive; the lots belonging to the State must be subject to the uniform plan of settlement, irrigation, titles, inscriptions and transfers which is established for the lands of the Company; and all transfers of titles shall be made in the great registration book of the Company, in order that the plan of settlement may be perfectly uniform.

Art. 26. In case there no longer exist in the Central Pampa the two thousand leagues to be comprised within the limits of the Concession, the deficiency shall be supplied from the available public lands which exist in the territories of Rio Negro and Neuquen and are nearest to the Rio Colorado.

In this last case the Company is bound to canalise and remove all the obstacles which may hinder the navigation of the Rio Colorado in all the rest of its course, lying outside the main line of canal projected, and throughout the whole extent of the lands of the Concession: to this branch of the principal canal are extended the same privileges granted to the principal canal, and the same obligations on the part of the Company.

Art. 27. The deed of concession shall serve as provisional title-deed to the Company to fix the situation and limits of the lands of the concession, and to transfer or let them to settlers or corporations, but the definitive deeds of possession shall be delivered to the Company in sections corresponding to the sections of

the canal to be constructed; and the fifteen hundred leagues shall be divided for conveyancing into sections equal in number to the sections into which the work is divided in the definitive studies.

Art. 28. The concessionary Company shall enjoy the right of expropriation according to the Act of September 13, 1866, for the acquisition of all those lands—no longer Government property—which may be necessary for the canal works or in order to render uniform the plan of colonisation and systems of irrigation, for rectification of the line of the canal or the course of the rivers which it utilizes, turns aside or follows throughout its whole length, for the ports and wharfs, for taking in water, for watering-places of cattle, small feeding canals, reservoirs or any kind of embankments or deposits for viaducts, water-cuts, hydraulic, telegraphic and telephonic installations: at the intermediary wharfs and ports 25 square kilometres may be expropriated, with the obligation to lay out a village or town; and at the towns formed at the termini of the canal or ports of bifurcation the expropriation may amount to 50 square kilometres.

Art. 29. The Company, along with the definitive studies, shall propose for the approval of the Government the names to be given to the canal and its dependencies, also to the towns, ports wharfs, and to the stations of the railway to San Rafael.

Art. 30. The Company shall also have the exclusive right of navigation throughout the whole extent of the rivers canalised from the starting-point down to the Ocean; and shall fix the tariffs, which shall be submitted to the approval of the Government.

Similarly the Company shall fix the dues payable at the port on the Ocean; these shall in no case exceed the dues fixed by the Government in the national ports.

Art. 31. The Company shall have the right to charge tolls for navigation from all the boats passing along the rivers and canals which are the objects of this concession, according to the tariff, which shall be submitted for approval to the Executive.

The ships of the National Navy and all boats in the service of the National Army or Navy shall be exempt from all navigation tolls and port-dues.

The Company's boats when employed by the National Government, and passages issued by the Government shall be subject to a reduction of 50 % upon the usual tariff.

Art. 32. The Company shall have the right to regulate, with the approval of the Government, the takings of water for use in irrigation, and to fix the tariffs; but they must always respect the rights acquired by the actual proprietors, without prejudice to the right of expropriation when it shall be indispensable for uniformity in the regulation and execution of the work.

Art. 32. The Company shall also enjoy exemption from customs-duties for all the machines, instruments and materials for the construction and management of the works of canalisation, as well as all the favours and immunities granted by the Settlement Act of October 19, 1879.

Art. 34. It shall also have the exclusive right to work the telegraphic or telephonic lines running along the Canal and its branches, also those of the railway to San

Rafael, and those which the Company may lay to connect together the Agricultural and Urban Centres comprised within the limits of the Concession.

The use by the Government of the telegraphic and telephonic lines for the public service shall be gratuitous.

The tariffs fixed by the Company for these services shall be submitted for approval to the Executive Government.

Art. 35. The concession with all its rights and privileges shall last for *sixty* years reckoning from the day on which the canal is opened to the public service throughout its whole extent: at the end of that time it shall become the property of the State, to which the Company shall deliver in a perfect state of preservation all that is specified in Art. 38.

Art. 36. The State shall continue the services of irrigation and all other matters concerning the working of the canal and its branches.

Art. 37. During the whole term of the concession the State shall not have power to grant to any other private enterprise any other analogous concession for canal or railroad in the territories of the Central Pampa or Rio Negro to run in a direction parallel to the line of the present canal so as to injure its traffic or development: nor shall the State construct any such on account of the Nation, nor through the whole extent of the concession grant any kind of industrial privilege which can invalidate or injure the privileges hereby conceded.

Art. 38. If the Company do not present the definite studies, do not complete the sections of the canal and do not open to the public service the whole extent of canal projected—saving cases of *force majeure* amply

proved—the present concession shall become null and void; and all the public lands which shall not have been definitely conveyed by deed in favour of the Company shall return to the power of the Nation, which shall have power to dispose freely of the said lands, when once the Executive has declared the present concession void.

The Nation shall also be sole owner of all the works of canalisation and irrigation, of the ports, wharfs, piers, deposits, reservoirs, in-takes of water, cattle watering-places, feeding canals (rigoles) viaducts, water-cuts, telegraph and telephone lines, work-shops for the generation and transmission of electric energy; the rail-road to San Rafael with all the buildings, installations, work-shops, means of transport, machinery and chattels belonging to the working and preservation of the same, whether they be the property of the concessionary Company or have passed into the possession of third parties: all which things must be delivered up in a perfect state of preservation, allowing for fair wear and tear.

Moreover all the studies and plans concerning the said services of the concession shall pass into the exclusive possession of the State.

Art. 39. Any difference of opinion which may arise as to the interpretation of the clauses of this concession, whether during the execution and completion of the projected works or in case of the concession being declared null and void, shall be settled by arbitration.

Art. 40. To be communicated to the Executive.

Given in the Committee Hall, September 24, 1896.

Alfredo Demarchi—E. Canton—C. Otaño.

Chapter IV.

TECHNICAL DESCRIPTION OF THE CENTRAL PAMPA CANAL.

The proposed Bill of Concession, as may have been observed, consists of three parts.

The first is that which refers to the outline or preliminary studies, which prove the practicability of the scheme, and to the definitive studies which are to regulate its construction.

The second part relates to the estimated cost of the work and the calculation of its probable profits.

The third deals with the situation of the lands conceded to the Company as compensation, with title-deeds, privileges and immunities of settlers, irrigation system etc.

We shall treat each of these topics separately, as concisely as possible. As to the first we quote the words of the distinguished engineer who is Director of the Technical Offices of the Company, Señor Romanini: he speaks thus in his report, written after more than two years of arduous labour on the spot:—

« Navigable Canals always have been and will be the means of transport which are most economical and involve the most obvious advantages for the districts

which they traverse, advantages not limited to facility, cheapness and convenience in the transport of all crops and merchandise, converting distant towns into safe markets: for they also favour most efficaciously the progress of population and agriculture, both owing to the encouragement offered to natives and foreigners alike by certainty in the demand, and also because the number of men and animals employed in ordinary carriage of goods being considerably reduced, a proportionately increased number are available for the settlement and cultivation of the land. »

« Inland navigation is conducted across valleys and hills, the boats mounting to the heights and descending with equal ease, to pass on again to other ridges and plains without meeting the smallest hindrance, nor any delay beyond the time necessary for filling each lock, in order that the boat within it may reach the upper or lower level of each canal-reach, according as it is travelling up or down. Navigation may be carried on by a river or natural water-course, or again by a canal opened in any given direction, or else by means of both methods employed together. This last is the system pursued in our project of canalisation. »

« River-navigation is always possible provided that the current is not excessively strong and that the depth of water is sufficient to float the boats destined for traffic when loaded »

« But those favourable circumstances are seldom found throughout the whole course of the river owing to the numerous obstacles which are met at every step, sometimes rapids or water-falls, sometimes a sudden narrowing of the channel, or considerable windings in

the course, then again great floods and flushes caused by the rains or by the melting of the snow etc. etc. The result is that rivers can seldom be used for navigation without adapting them for the purpose, that is to say *canalising* them. »

« The canalisation of the fluvial artery with which we are concerned, consists in establishing locks at convenient distances, in order to bank up the water and increase the depth, equalising as far as possible the current within the limits suggested by science and experience. Since the highest point (Villa Azara) is 689 metres above the mean sea-level, and the total length of the canal is 986,000 metres, we find that the average fall of the whole course is 0.000069 per metre. There are however some reaches where the fall is excessive, being as much as 0.001771 in the reach lying between La Angostura and Las Gallaretas. But here the velocity of the current oscillates about two metres per second, and may be compared with that of the Rhone at Lyons (2.30 metres). A special system of towing is in this case more efficacious and economical than locks; but this is the sole exceptional case, and we defer the solution of the problem to the definitive studies. »

« The dykes which form the dams shall be of clay, carefully set and rammed down; and their inclination shall be 5 of base to 1 of height for the up-stream face and 2 of base to 1 of height for the down-stream face of the dam. The overflows, (*diversoirs*) shall be constructed in steps, faced with stone masonry set in hydraulic cement, the foundations to be secured by struts and stays.

Each dam shall have two flood-gates furnished with hydraulic apparatus to work them. The flooring and piers of these gates and bridges shall be of iron. »

« The object of these overflows and flood-gates is to let out the surplus water brought down by floods and store it uniformly in the 22 reservoirs ranged in scale along the canal, thus precluding the injuries which might be caused by an inundation or by too rapid variations in the level and velocity of the water. »

« The locks may consist of one isolated pool or of two, three or four in succession according to the fall of water (in no case shall this exceed five metres). The materials used in the construction of these locks shall be cut stone or compressed brick, set in good hydraulic cement: the foundations shall be firmly laid upon struts and a bed of cement; the gates shall be of wrought iron and shall be moved by hydraulic apparatus. »

« But in the parts where the fall is greater, as in the reach between Villa Azara and Las Gallaretas and between Lake Urre-Lauquen and the Rio Colorado, *inclined planes* may be substituted for the costly and complicated system of locks which we have designed. »

In France, Holland, England and the United States there are many of these *inclined planes* of various slopes and lengths. M. Betencourt states as the maximum limit of inclination 47 centimetres per metre. On the Shropshire Canal in England there are three planes which rise 30.50, 36.40 and 63 metres in the lengths of 293, 548 and 530 metres respectively. In Holland there are many which have a fall of 20 centimetres in the metre, which are surmounted by boats of 8 or 9 tons with the labour of one man and a wheel 7 metres

in diameter. These inclined planes consist of an ordinary causeway upon which are placed rails as for a railway, along which roll the *cradles* upon which the boats rest. »

« The cradle having been placed on the tramway under the water, the boat is placed on it and well secured: then it is hauled up by chains wound round a capstan until it reaches the higher end, where there is a bascule platform to facilitate the immersion of the boat in the upper reach of the canal; for the inclined plane and tramway rise to a point calculated with regard to the water in which the boat is to float. The platform is worked by means of windlasses worked by men, horses, steam or hydraulic machinery.

« With hand labour, not more than sixteen minutes are usually necessary for each boat; so that in the course of eight hours thirty empty boats can descend and thirty loaded ones mount a height of 40 metres. »

« The cost of building these inclined planes is 55 % less than that of locks. » On the banks of the canals and on the slopes of embankments, dykes etc., shall be planted trees with wide-spreading, not deeply penetrating roots and close-growing branches, in order to beautify and consolidate the works. »

« Admirably adapted for this purpose in the climate of the Pampa are the osier and Pampa willow (*Salix Humboldtiana*), also foraginous plants such as alfalfa (*Medicago sativa*) and other plants having strong creeping roots, as the *Lotus corniculatus*, the *Hedysarum coronarium*, *Ornithopus sativus*, *Elymus arenarius*, *Tizania aquatica* etc. etc. »

« All the dams or storage-pools are situated in

advantageous positions for drawing thence irrigating canals for the lands comprised in the concession. »

« On the Rio Colorado, exactly in the spot indicated in the preliminary plans, shall be constructed a great dam, with embankment of earth and stone, having an overflow in the centre and flood-gates at the sides, also two outlets or shoots of water, one at each side, of which the Northern one shall supply water to the feeding and irrigating canal of Vuta-lel-vun, and the southern one shall supply water to another irrigating canal which is to traverse the lands conceded to the Company to the south of the Rio Colorado. »

« Both the canal of Vuta-lel-Vun and also the section comprised between the 930th Kilometre and Brightman Bay or Port shall consist half of excavation and half of embankment, and shall serve the double purpose of navigation and irrigation. »

« As a port on the Atlantic Ocean, Brightman Bay or Cove is far preferable to the mouth of the Rio Colorado. The bay is situated between Green Island and the mainland; its bar lies about 50 kilometres South-East (1/4 to the South) of the light-ship of Bahia Blanca. The entrance to the bay is about two cables wide and its depth at low tide is six feet (1.828 metres) according to information obtained from the ship-masters who frequent this spot in order to carry away in sailing-ships the produce of the Establishment of Messrs. Pedro Luro and Sons. This bar can easily give access to ships of 10 feet draught (3.047 metres), since at high tide there are usually 14 feet of water (4.267 metres). The anchorage within the port is sufficiently secure, of ample

depth, and sheltered from all the winds, notwithstanding its proximity to the sea. »

« Our preliminary studies show how by dredging the bar it would be possible to give free entrance and exit to ships drawing 20 feet (6.09 metres), since, once past the bar, there is everywhere sufficient water for merchant ships of moderate tonnage, for the depth (at the average water-level) varies between 2 fathoms and 7 fathoms. »

« As for the beacons for this canal the most economical system is that of fixed beacons on shore: but buoys fitted with electric lights and bells—as in the Port of New York—are much to be recommended.

« As to means of living, fresh meat and fish are there found in abundance; and fresh water fit for drinking comes in two water-cuts drawn from the Rio Colorado to irrigate the establishment of Messrs. Pedro Luro and Sons (mentioned above): Besides, if wells are dug in Green Island, fresh water is found at a depth of 8 feet. Below this is the hard clay (tosca).»

« No error has been made, we feel sure, in choosing Brightman Bay as the Southern Terminus of the Pampa Canal.

« Suggestions coming from outside have led to a modification of the original canal project, the section San Rafael—Primera Angostura being suppressed. The objection was made that the water of the River Diamante ought to be applied exclusively to irrigation, and that a navigable canal would absorb its entire water-supply, to the detriment of the cattle-industry and Agriculture, etc., etc.»

« These suggestions are mistaken and absolutely without scientific foundation, since the water which has floated a boat can be afterwards used to irrigate a farm. In the former case the water remains, in the latter case it is lost; part evaporates, and part filters into the soil. Both banks of the River Diamante are covered with pools and almost impenetrable masses of rank grass known as the swamps of Bom-bal to the north, and to the south the swamps of Requeiro and Monte Conion. »

« These marshes are due to want of system in irrigation and drainage: thus are produced these extensive basins of evaporation and infiltration, in which thousands of cubic metres of water are continually wasted. »

« However it was necessary to abandon the more practical and scientific plan of the canal-section San Rafael—Primera Angostura, and substitute for it a branch of railway utilizing for the purpose of electric traction the power produced by the Niguil water-fall: this varies between 40,000 and 80,000 horse-power according as the River Atuel rises or shrinks in volume.»

« This is a valuable supply of natural energy, which, if it be intelligently applied, will confer no scanty advantages both on the Company and on individuals. »

« For the present the Undertaking will only make use of the power required to work the electric railway from Villa Azara to San Rafael, and if it be necessary, for the installation of machinery at the ports of Azara and Primera Angostura: but it can be applied to many other profitable uses, especially to the electric trans-

mission of force to the coal-mines, and a branch railway (also electric) to convey the coal to the boats of the Company, to be thus carried and distributed along the banks of the canal through the extensive region of the Pampa. As to this, Elisée Réclus writes thus:—»

« The fuel of San Rafael,—a true coal burning with a clear flame—equals English coals of average quality. The beds already explored are numerous; and one of them, in the Eloisa mine, is not less than four metres thick. Everything appears to indicate that the beds succeed one another southwards into the territory of Neuquen, underneath the Jurassic strata. »

« The same region contains petroleum, alabaster and limestone, all workable. Besides this, the cinders of the San Rafael fossilised coal contain a large proportion of *vanadium*, the salts of which are the best mordants for aniline dye (Juan Kyle, *Revista del Museo de la Plata* 1893); but the fine beds of coal are found at a great height of from 2,500 to 3000 metres, and during the winter layers of snow cover the upper strata (Rodolf Hauthal, same collection). Thus it would be very difficult to work this coal with profit, and it is being kept in reserve until the River Diamante be made navigable and railways climb these mountains. (Elisée Reclus, *Geographie Universelle* Vol. 19, p. 725-6.) »

« Pelton wheels would be, in our opinion, the best means of utilising the hydraulic power of the Niguil water-fall.

« This form of hydraulic receiver is much used in the United States, especially in the mining districts of California, owing to its ease of adaptation and its

yield of transmitted power, which reaches 80 and even 87 per cent. »

« The Pelton wheel is a sort of driving turbine with a horizontal axle: it is especially suitable for great falls of from ten metres up to a hundred and more metres and for transmitting power from $\frac{1}{20}$ horse-power up to 5000 horse-power.

« The electric machinery to transmit the force to a distance would thus be extremely simple, viz;—

(a) A channel of cast-iron pipes from the top of the cascade to the bottom.

(b) Two or more Pelton wheels (according to requirements) coupled directly with the dynamos.

(c) A building to protect these machines, and also to contain an office and dwelling-rooms for the men. »

« From these Works the principal conductors or feeders at high pressure (25.000 to 30.000 volts) would reach to "La Rama Caida", which is the mid-way point between Azara and San Rafael. Here the alternating current at high pressure would be transformed into a continuous current with a power of 600 to 500 volts, which would work the motors of the railway waggons.

The current will be transmitted by an over-head line and will return by the rails and it will be possible for forty waggons of ten tons each to travel on the line at the same time. » (1)

(1) Report of E. Romanini, Civil and Hydraulic Engineer, technical engineer of the Undertaking.

Chapter V.

ESTIMATE OF COST OF THE WORKS PROJECTED

We will now pass on to give a general summary of the cost of the works of the canal and of Port Rightman, with all the dams, excavations, wharfs, dykes, barriers and gates.

These calculations have been made after an analytical study of the separate estimates and with the assistance of the other Engineer of the Undertaking, Señor Don Rodolfo Moreno, chief of the department of calculations.

*General Summary of the Cost of the works of the
Canalisation of the Central Pampa* ⁽¹⁾

	Paper Dollars
1.° <i>Moving of Earth</i> (excavation, loading, transport, unloading, setting and tamping) 9.000,000 cubic metres	7.200,000
2. <i>Masonry of Stone or Brick, Mortar, etc.</i> (for the overflows, conduits, etc) 487,000 cub. met. at \$ 12	5.844,000
3. <i>Locks.</i> 2 single locks at \$ 225,000	450,000
8 double locks at " 300,000	2.400,000
10 triple " at " 420,000	4.200,000
1 quadruple " 500,000	500,000
4. <i>Quays, wharfs and secondary dykes</i> (palisades, struts, stays, fascines).	2:200,000
5. <i>Plantation and Sowing</i> to consolidate the face of the dykes, etc., etc.	500,000
6. <i>44 Flood-gates</i> with the corresponding hydraulic apparatus to work them (\$ 20,000 each)	880,000
7. <i>Port in Brightman Bay</i> (dredging, beacons; lights, quays, etc.)	2.000,000
8. <i>Expropriations</i>	500,000
9. <i>Buildings, work-shops, forges, offices, etc.</i>	500,000
10. <i>Electric Railway</i> (Azara—San Rafael) 25 kilometres	640,000
11. <i>Fleet of 71 tugs and 710 barges of 10 tons.</i>	1.000,000
Total Cost \$	28.814,000

(1) Romanini and Moreno.—Report presented to the Projectors.

It is seen that this estimate of cost is based solely on prices in Argentine paper money, which at an exchange of 300 gives a total of 9.605 666 gold dollars, or 1.921.133 sterling.

Calculating besides some unforeseen items and differences in exchange, (which has fallen to 280) the total estimate of the work is raised to the round sum of £ 2.000.000.

Chapter VI.

SUMMARY OF PROFITS

In forming an approximate calculation of the returns which the constructing Company will get from this colossal work, the following points must be borne in mind:—

1. That in calculating the receipts we have taken the minimum figures.

2. That the working of traffic is generally handed over to private contractors, who contract with the Company and remain under its direction and control.

3. That we have not included in the receipts the freight for carrying minerals, as limestone, gypsum, alabaster, onyx, granite, porphyry, petroleum, coal, puzzolana from the Diamante mountain (where this abounds), salt and metalliferous minerals, nor the carriage of timber and fuel from the great woods which exist on the banks of the Atuel and Chadi Leuvu: we have omitted these items for want of a basis of calculation; but when they come to be worked, they will assuredly double the value of the traffic at least.

FREIGHTS, TRANSPORT.

1. Movement of produce and goods, calculated on an extent of 600,000 hectares of tillage and pasture land

ten years after the canal and irrigation works have been brought into action.

	Tons
Cereals, hay, roots.	480,000
Hides	4,000
Wool	12,000
Meat, fat, tallow	10,000
Horns, bones	10,000
Wines, fruits, skins, feathers . . .	3,000

Total:— Tons 519,000

The total length of the canal being in round numbers 1000 kilometres, we shall find that the average journey of each boat will be approximately 600 kilometres.

600 kilometres at 12 dollars paper—which is the lowest freight on the rivers Paraná and Uruguay—give 6.228,000 dollars paper.

Supposing each convoy to consist of ten barges, each of ten tons, with a steam-tug at an average speed (including stoppages and the time required for passing the locks or inclined planes) of 120 kilometres a day, we get 5 days for the journey of 600 kilometres.

$\frac{519,000}{965} \times 5 = 7109$ tons of merchandise, as daily movement: divided into ten-ton barges this movement requires 710 barges and 71 steam-tugs for the 710 barges at 10 barges to each convoy.

Thus we get:—

71 Steam-tugs of 25 horse-power at	Papers dollars
\$ 8,000 paper each	568.000
710 ten-ton barges at \$ 1,000 . .	710,000

Total . . . 1.278,000

In the general estimate we find this item reduced to one million, since the purchase *en masse* of these boats in the European building-yards, admits of this reduction.

Thus supposing the annual movement is 519.000 tons, carried by this fleet of boats, we get (as we have seen) as gross receipts \$ 6.228,000

Deducting the expenses:

For Fuel (50,000 tons wood) oil, cotton waste for the machines, replacements and repairs; in the year	\$ 854,000 . .	<u>854,000</u>
Crews of the tugs, mechanics, assistants, stokers, labourers etc.	\$ 459,580 . .	459,580
Barge-men		<u>1.292,000</u>
Total labour-bill of the boats . .		1.751,580

LABOUR-BILL OF THE LOCKS

Foreman \$ 200	Number of Locks	
22:	4,400	
Assistant \$ 120	2,600	
120 Lock-men \$ 100	<u>12,000</u>	
Monthly	19,000	
Annual Total		228,000

SUMMARY OF THE COSTS OF WORKING

Fuel	854,000
Labour	1.751,000
Locks	<u>228,000</u>
	2.833,000

Gross Receipts in the year	<u>6.228,000</u>
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Balance: Net receipts	3.395,000
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Supposing that these net receipts do not increase proportionately during the sixty years of the concession,

and taking as the average annual profit only the sum of three millions, still we find that the Company would gain in the sixty years of the concession the sum of

\$ 180,000,000

PROFITS OF IRRIGATION.

In calculating the profits of the irrigation, we have taken three factors into account:—

1. The average monthly consumption per hectare on the principal canals of Europe.

2. An irrigated surface of about 600,000 hectares, on the banks of the Atuel and Chadi Leuvu as well as the Rio Colorado.

3. An exceedingly low price in order to stimulate agricultural development and the consumption of water.

The supply of water now actually available from the rivers Chadi Leuvu and Atuel—without the reservoirs which the Company will construct to double the available volume of water—is about 10 million cubic metres daily, or 300 million cubic metres monthly.

This mass of water can be doubled or trebled at will by means of the reservoirs to be formed by dams, according as the needs of the irrigation require it.

300,000,000 cubic metres at the rate of 2000 cubic metres a month per hectare, give an irrigated surface of 150,000 hectares.

An equal extent can be irrigated on the banks of the Rio Colorado, so that we shall get 300,000 hectares of irrigated land, which can be doubled or tripled by the storage of water.

Calculating only twice the amount, we shall get 600,000 hectares irrigated, at the rate of 2,000 cubic

metres a month, or 24,000 cubic metres a year, which means a consumption of 0.77 litres per second, that is to say, rather more than the consumption on the celebrated *vega* of Valencia, where 0.73 litres a second per hectare are used, according to the authorised scale of consumption of water in Europe, as given in the classical work of Durant Claye. (1)

The usual consumption in France is one litre a second per hectare (2); in the Milanais in Italy it is 1 $\frac{1}{2}$ litres in some places, in others much more, since the irrigating water, proceeding from the melting of the Alpine snows, is very abundant, so that any quantity is always available (3): this will also be the case in the Pampa, where both from the Atuel and the Colorado an unlimited quantity of water can be stored in reservoirs.

The consumption of 0.77 litres which we have taken as our basis—although it is more than sufficient for the irrigation of cereals, which requires less water than that of market-gardens—can be raised, it must be understood, to twice the amount, when it is required; for the supply provided by the thaw of the Cordilleras in summer being inexhaustible, and rain being plentiful in winter and spring, the whole thing can be reduced to the proportions which would be given to a work of art.

(1) Durant Claye:—Hydraulique Agricole et Genie Rural. Vol. II, p. 351.

(2) Laguna Aguas y Riegos.

(3) Ibidem p. 127.

According to the work of Durant Claye, the average consumption in some parts of France, as Normandy and the Vosges, and in the Campine in Belgium is much more than 2 and even 3 litres a second per hectare.

Mendoza and San Juan possessed in the year 1888, the former an irrigated surface of 157,250 hectares, the latter one of 92,388 hectares. (1) It may be reckoned that this extent has now been doubled, especially in Mendoza, since the dyke and reservoir have been made on the Sanjon.

Although we have no precise *data* of the water used per second to the hectare in these two provinces, we may confidently assert that the continuous consumption does not reach one litre.

From these explanations it is clear that the Company will have water in abundance available to irrigate an extent of 600,000 hectares at the rate of 24,000 cubic metres to the hectare annually, or (which is the same thing) a continuous irrigation of 0.77 litres a second to the hectare, which is much more than the average consumption in Spain (2)

Now the annual prices for water-supply are in Mendoza \$3 per hectare plus \$4 additional; total \$ 7.

In San Juan per «square» of $1\frac{1}{2}$ hectares « 6.50

If the Company fixes as the charge for annual consumption the sum paid on the lands of Mendoza, viz seven dollars a hectare, we shall get the following result as profit on irrigation:—

600,000 hectares at the rate of \$ 7 a year .	4.200.000
Cost of working, reckoned at 20 % . . .	<u>840.000</u>

Balance: net profits:— 3.360,000

It is evident that such returns may well satisfy the ambition of the capital employed in these works.

(1) Latzina. Geografia de la Rep. Arg. p. 390 and 404.
(2) Laguna. op. cit. p. 130.

It remains for us now to calculate the profits which the Company may draw from the sale of the lands conceded to it, which must go up in value in consequence of the canal and irrigation works.

This increase in value, although slow, is certain: by way of example we may study and describe the rise in value of the lands of the Province of Santa Fé, which in the Argentine Republic is called the wheat region.

But the exposition of this subject with due documentary evidence requires a chapter to itself.

Chapter VII

LANDS AND SETTLEMENTS. YIELD OF PROFITS

By the 24th Article of the Private Bill as issued by the Parliamentary Committee of Public Works, the Nation concedes to the Company (which asks for no guarantee of any kind) by way of entire compensation—in addition to the exclusive working of the canal for 60 years—2000 square leagues of land; of which 1500 shall be the property of the Company, while 500 are reserved as the property of the government within the limits of the concession; the situation of these last to be alternated with the Company's lands so that in each section there shall be three adjacent lots for the Company, and one lot for the State.

Owing to this happy and patriotic combination, suggested by the distinguished President of the Parliamentary Committee of Public Works, Señor Demarchi, Congress-man and Engineer—who, it is fair to say, has defended inch by inch the interests of the public purse—the State as partner enters upon a fourth part of the profits to be obtained by the Company from the sale of the lands, without however disturbing the unity of the general plan, irrigation, titles, transfers, proprietary

rights etc., etc. to be uniformly adopted by the Company for the settlement of their lands.

Under this prudent, patriotic and equitable arrangement all the susceptibilities must disappear which might arise in the future from a feeling of rivalry or selfishness in presence of the profits which the Company may succeed in realising.

Confidently anticipating this result, the projectors accepted without hesitation this form of partnership with the State, which thus becomes interested in the progress of the enterprise and in smoothing away any difficulties which may arise in practice—in order to serve the common interest, which in this case is identified with the general interests of the country.

In soliciting instead of a guarantee to capital a compensation in the form of land, the projectors have taken two things in to account.

First the financial condition of the country, which is still struggling to solve the difficulties produced by the past crisis: this might perhaps have impeded the concession by Congress of a work equally promising and colossal, or at least might have delayed its concession—to the loss of the country—until the state of the finances and the settlement of the railway guarantees should have cleared the horizon and permitted the country to engage its credit by encouraging works of this kind.

The second point which we have held in view is the fact that primes or compensations of this kind to stimulate capital have been the means of producing such marvellous results in the great Northern Republic, where in a few years a vast country has been crossed in all

directions by numerous net-works of railways and canals, the railways being counted by thousands of miles (1) and the canals by hundreds of miles, as may be seen at page 466 of the above-quoted work.

All these constructive works received from the foresighted generosity of the United States Congress large subventions of public lands, and especially the four great inter-oceanic railways which join the Atlantic to the Pacific.

To avoid excessive prolixity, we will note here the total figures, referring the reader to the erudite work of the Economist above-quoted for complete details of the subject.

These subventions in the year 1882 reached the round sum of 200 millions of acres, (2) of which only 159,486,776 acres went to the inter-oceanic lines (3)

The political economy of the United States has been no less lavish and foresighted with regard to canals: these have been constructed with not less energy and rapidity than the railways, and according to the same writer have contributed no less by their concurrence towards the astonishing fall in freights, which has introduced into the markets of Europe that competition

(1) According to Egisto Rossi, up to the year 1882 the United States had built 104,813 miles of railway, at a total cost of 4,623,609,297 dollars.

The United States possess one mile of railway par 540 inhabitants: Europe has one mile per 3000. During the following years new lines have been built to the value of nearly 1501 millions of dollars. Rossi; *Lo Concorrenza Americana* é *gli Stati Uniti* p. 452.

(2) The hectare contains 2 1/2 acres.

(3) E. Rossi op-cit. p. 441.

which so deeply alarms and threatens European production.

And this fabulous development which, starting from the successful example of the Erie canal, has led the United States (as we said in our Memorial) to extraordinary activity in constructing lateral canals along the rivers, following the river-courses and utilizing their water only as a feeding supply—among which canals we instanced the Hudson Canal, parallel to the Delaware River, the canal parallel to the Susquehanna, the Chesapeake canal parallel to the Ohio, the canal parallel to the river Potomac and ending at Washington and many others described in the works of Chevalier and Malezieux:—(1) this prodigious development (we said) is due to the ample protection of the State, which up to the year 1883 had granted to Canal Companies more than 4,424,073 acres of public land (2).

These subsidies have followed in increasing proportions and have stimulated the Dominion of Canada to act in a similar manner, not only towards railways, but also towards canals (3), so much so that the great Welland Canal in Canada is to-day the most formidable competitor of the Erie Canal and even threatens to out-do the latter in traffic: in fact Canada has spent not less than 150 million of francs to encourage such works. (4)

Neither of these two peoples has spared money, land or efforts of any in order to bestow on their respective countries *longa manu* these admirable net-works

(1) Vois de Communications des Etats Unis.

(2) E. Rossi. op. cit. p. 462.

(3) Zeballos op. cit. p. 554.

(4) E. Rossi, op. cit. p. 468

for trans-continental locomotion, which have almost annihilated freight as a factor in commercial circulation ; for instance the convoys of barge-lines which come down the Mississippi, competing with the canals and railways from Chicago to New York and from Kingston to Quebec, carry thousands of tons of wheat with the traction of a small steamer or tow-boat, at very small cost.

The development attained by this system of convoys of barge-lines, says an orator of the Produce Exchange of New York, is simply prodigious, and enables *one single steam-tug to convey from St. Louis to New Orleans 11,000 tons of wheat, that is to say a quantity which would require 60 trains to carry it, attended by 350 men.* (1)

« And the other means of communication » exclaims Rossi, « such as bridges, high-roads, telegraphs, telephones etc. are in proportion to the greatness of the canals, rivers and railways.

Thus after familiarizing ourselves with the industrial and commercial grandeur of that great country—so ably described in the notable work of the great Italian economist—we feel no astonishment at the facts related by Dr. Zeballos in his recent work: rather we regard them as logical and natural consequences of this gigantic combination of works of progress.

Thus for instance, considering the natural magnificence of the great lakes, their communicating straits and the enormous development of agricultural production which reaches their shores, it does not surprise

(1) E. Rossi op. cit. p. 546.

(2) Id. p. 468.

us that in the year 1890 a commercial movement of more than 36 millions of tons passed the single port of Detroit, situated on the natural canal which joins Lake Huron with Lake Erie, whereas the ports of Liverpool and London together scarcely had a movement of 37 millions; (1) nor yet are we surprised that through the Saint-Marie canal, joining Lake Superior with Lake Huron more tonnage passed in 233 days than in the whole year through the Suez Canal, which is the connecting link not only between two seas, but between two worlds. (2)

Thus our enterprise being placed in a condition analogous to that of the Canal Companies of Canada and the United States, will finally become, like them, the *colonising Agency* of the State: for the Company will be led by its interests to dispose of the lands received as compensation, in a prudent and reproductive manner among the settlers who are to occupy and cultivate them.

This system of settlement and of constructing public works is unknown in Europe, where the scarcity of public land precludes such concessions; yet by them, the interest [which the concessionaries have in occupying and improving the soil to increase production and traffic, is combined with the interest of the State; which is in fact identical, although the object be to increase the Revenue.

Leaving these general considerations as to the mutual interests of such enterprises and the State—a matter which has been sufficiently proved by the ex-

(1) Zeballos op. cit. same page.

(2) Ibidem.

periences of these Northern countries we pass to the details of our own enterprise, in order to enquire what will be the profit derived by the constructing Company from the lands granted to it by the Bill of Concession.

The territory thus granted, according to Article 24 of the Bill, shall contain 2000 leagues, of which the State reserves for itself a quarter, or 500 leagues, and grants 1500 leagues as the absolute property of the Company.

Sketch N.º 4 will give an approximate idea of the situation of these lands: as will be seen, this plan cannot be carried out on both sides of the canal, because more than two-thirds of the territory of the Central Pampa has been improvidently sold. (1) Accordingly the area conceded must be completed with lands in the Territories of Neuquen and Rio Negro on both banks of the River Colorado. (2)

According to the last Statistical Annual of Dr. Latzina (8) and the official pamphlet of Lieutenant-colonel Rodhe (4) on the national territories, the highest price reached in the sales made of several of the sections into which the Pampa territory is divided, is \$ 6.50 per hectare, and the lowest price \$ 2, neglecting fractions. The average price may then be fixed at three

(1) Latzina (p. 542) criticizes with reason the method of these sales in the Province of Buenos Aires as well as in the Pampa—originating the *latifundia* which were so fatal to ancient Rome and which are the chief obstacle to settlement on the basis of property acquired by the settler. Dr. Zeballos also laments this unfortunate distribution of the land, which has been seized upon by speculation, a state of things most unfavourable to immigration.

(2) Latzina anuario del 94. p. 184

(3) J. Rodhe.

(4) Article 28. Bill of Concession.

dollars: this gives a price of \$ 7000 for the kilometric league of 2500 hectares. Fortunately no sales have yet taken place west of the Chadi Leuvu, where about 700 leagues still remain unalienated.

What will these lands be worth when once the canal is completed, the wharfs and ports constructed, the riparian villages and towns founded, each one to be the centre of an agricultural settlement—for all which purposes the Company will have the right to expropriate land which has passed out of State possession—(1) when also the port in Brightman Bay has been constructed and the works of general irrigation finished? To make this calculation, we have at hand only comparative data, viz. the value attained by the lands of the Provinces of Buenos Aires and Santa Fé, lands subject to conditions far inferior to those which will give value to the lands of the Central Pampa.

Taking for basis the Province of Santa Fé, the one which offers most resemblance to the Central Pampa in its rapid progress in settlement and population, we may adduce the following facts:—

In the year 1866, under the administration of Dr. Oroño, land was offered for settlement at the rate of \$ 300 a league, without finding buyers.

Twenty-two years later, under the progressive administration of Dr. Galvez who succeeded in giving such an impulse to the Province under his government by a number of well-directed economic measures, these lands—according to the well-informed writer of the Census of the year 1888, Dr. Carrasco—reached a value of more than

(1) Report presented to the Projectors by the chief of the Section of Lands, Dr. Don Guillermo Godio.

100,000 dollars a league, (1) and the value of the hectare fluctuated from 20 to 100 dollars:

At the present time (that is to say, eight years later) according to the latest data, which we have before us, the value of these lands reaches the enormous sum of 200,000 dollars a league in the settlements nearest to railway-stations.

Let us study the factors which have contributed to such a rapid increase in value in less than thirty years.

First comes the clear-sighted and liberal policy of the Governments of this province, who have taken seriously the famous aphorism of Alberdi: «To govern is to populate, and to populate is to govern.» (2)

The second factor consist in the railways: — a movement which was begun by the Central Argentine Railway in 1863, (3) was continued in 1882 by the Western Santa Fé line, the line from Rosario to Candelaria, the line from Santa Fé to the Colonies where it divides into several branches, the line from Buenos Aires to Rosario and Sunchales: all these lines form a net-work of more than 3000 kilometres. (4)

(1) Carrasco: — Censo Agrícola: Provincia de Santa Fé, Año 1888. sheet II. p. 10.

(2) «La Produccion Nacional»: 2nd. Year, N° 27.

«The Price of Land»: Province of Santa Fé. Report of Señor Juan H. Alsina, p. 15.

(3) In this regard we may be allowed to offer well-merited applause to the progressive Government of the enlightened Dr. Don José Galvez, during which the first census of the province was made under the direction of that competent Statistician Don Gabriel Carrasco, and the chief institutional laws of the province were passed, as well as the principal railway concessions and the most liberal land laws; also the frontier was defined between the provinces of Santa Fé and Santiago, and the former acquired more than 14,000 square kilometres of land and five villages, with a population of 7,000 inhabitants.

(4) Carrasco: Census of 1888.

The third factor of this enhanced value is the fertility of the lands of Santa Fè, although they get no other fertilizing irrigation than the rain; for which reason, notwithstanding the 3,458,392 hectares under cultivations, "intensive" agriculture is as yet unknown. (1)

The resultant of all these factors could not fail to be a prodigious increase in population, and a spontaneous current of immigration—uninterrupted during thirty years—which has raised the population from 41,261 inhabitants, the number shown by the first count, made in 1858—to 220,332 inhabitants, which it was proved to possess in 1887, when the first census was made, (2) and finally to 405,369 inhabitants, which this rich Province possessed in the year 1892 according to the latest statistics. (3)

Naturally, the factor of immigration, which according to the same author of the Census, represents more than 70 per cent of the total population of the Province, (4) was sure to produce simultaneously an unusual movement in the progress of agricultural settlement.

And such has been the fact. In the year 1865, when the settlement movement began to take a decided direction—of which the initiative is due to the

(1) Paper by Dr. Juan A. Alsina, published in the "Produccion Nacional", p. 7.

According to the Report of the ex-Minister of the Interior, Dr. José V. Zapata, in the year 1892, the cultivated surface was 2,902,000 hectares.

In 4 years it has increased by 586,392 hectares,

(2) G. Carrasco. Census of population p. 11.

(3) Latzina. *Anuario* of 94. p. 539.

(4) The Italian population alone represents this percentage; second in order come the French, then Spanish, Swiss and Germans. Carrasco: Censo p. 25.

progressive citizen Don Araon Castellanos—there were but three settlements in existence. In the year 1884—nineteen years later—the number of settlements established and flourishing reached ninety: in 1888, the year of the first census, there were a hundred and ninety settlements, and at the present time they exceed three hundred and fifty-three, with a superficial extent of 3,458,392 hectares, (2) of which 1,613,402 hectares have been cultivated by plantation of trees, sowing of cereals and other crops. The growth of the population—both native and immigrant—which has increased the number of settlements by 200 per cent in less than thirty years, extending the area of cultivation to nearly two million hectares,—has necessarily raised the price of land, which now has a truly prodigious value compared with the «no demand» prices of thirty years ago: in fact Rivadavia's Utopia has been realised before the setting of the Century's glories.

After noting these eloquent figures we feel convinced that we cannot offer to the consideration of European financiers and to the patriotic judgment of Argentine public men a clearer mirror to reflect the future of the canalisation of the Central Pampa, then this picture of the Province of Santa Fé.

The same marvels which irrigation and settlement have effected in Santa Fé in less than three decades—cannot they also be accomplished in the Central Pampa, whose climate, soil and fertility yield in nothing to those of the province of Santa Fé? No-one can accuse us of exaggeration in seeking within the country itself these instances of the enhanced economic value of the soil. Accordingly taking for basis the rise in land values in

Santa F  , we may confidently expect that the Central Pampa lands, which are better off with regard to transport, irrigation, system of titles and homesteads, will reach *at least the same value* in a shorter time.

It will not require any great effort to prove that the economic and agricultural conditions of the lands of the Central Pampa, Neuquen and both banks of the Rio Colorado are better than those of the Santa F   lands.

In the first place the lands of Santa F   have neither irrigation nor abundant water-courses in the Department containing the settlements, although the Departments near the Paran   are supplied by the water brought down by some of its affluents, as the San Javier, the Salado, the Saladillo and others.

The same sheets of subterranean water, which according to Latzina and Moussy account for the fertility of the soil of Santa F  , are to be found at about the same depth in the neighbourhood of the Central Pampa. (2)

On the conclusion of the great works of the canal and those on the Rio Colorado, the Pampa lands

(1) Latzina: Geografia Argentina p. 305.

(2) Studies on the water of the sub-soil of the Pampa by the Engineer Don Rafael Hernandez: in the *Nacion* of Buenos Aires N.   6946. According to this competent engineer, the first sheet of water is found at eleven metres below the surface in wells sunk by Daicreux (at Chivilcoy) and at 36 metres occurs the second sheet of water rising up and inexhaustible. In the wells sunk under his direction in other parts of the South of the Province of Buenos Aires the first sheet is found at 5 and at 11 metres at Petmajo, the second at 13 and 31 metres. In the *Nacion* of April 17, 1893 an article appears by the same engineer on the potable and excellent qualities of the water of the second subterranean sheet of the Province, containing a qualitative analysis of this under-ground wealth: the conditions in the Central Pampa are identical.

will have abundant, permanent and cheap irrigation, which will always facilitate normal cultivation and a sure harvest, and will enable *extensive* agriculture to be turned into *intensive* agriculture, which quadruples the production and in consequence the value also of the land.

Nor is this the sole advantage over the Santa Fé lands which the Pampa lands will possess as an efficient factor towards increased value — in the near future, when they begin to be worked by cultivation.

The chemical composition of the lands of the Pampa and the valley of Neuquen, as also of the Rio Colorado, is considered to be superior in richness to that of the Santa Fé lands by the *savants* who have studied both.

As the best proof of this matter, we refer the reader to the scientific study made in the year 1823 by the distinguished Professor Döring of the University of Cordoba, as to the chemical and physical characteristics of the Pampa soil, for the Annals of the Public Museum of Buenos Aires.

« In agricultural chemistry », says Dr. Döring « it is known and proved that those kinds of land which owe their origin directly to the detrition of primitive eruptive rocks (the same kinds of land which compose the flourishing valley of the Rhine in Europe and the no less famous valley of the Nile in Africa) are considered as the most favourable to cultivated plants (Mülder Chemie der Akerkrume Vol. 1, p. 575); and a brief glance at the composition of the soil of the Pampa will enable us to describe it — with regard to the

inorganic sustenance of plants—as most favourable and almost *inexhaustible*. » (1)

Whereas therefore the dominant characteristic of the agriculture of Santa Fé is the growth of cereals, whose price is daily sinking in the markets of the world, and whereas stock-raising there depends solely on the fertility of natural pastures, exposed to frequent droughts and to periodical plagues of locusts—which appear to have their den of devastating incubation in the Chaco; meantime the lands of the Pampa, free from the locust, flanked by navigable rivers and irrigation canals, and gifted with an amply proved superiority of chemical composition for agriculture, are suitable for every kind of cultivation—cereals included—such as the vine, the olive, the mulberry (as the basis of silk-worm cultivation), fruit-trees, flowering shrubs, alfalfa or lucerne, beet-root and many others which need not be enumerated.

The cultivation of silk, which has brought life and effected an economic transformation in the States of Guadalajara and Jalisco in Mexico—whose latitude and climate are analagous to those of the Central Pampa—is one of the industries which are destined to prosper in the latter, On this subject we recommend the article on mulberry planting and silk cultivation published by Dr. Barcena, Secretary of the *Ministerio de Fomento* in Mexico. (2)

If we compare the climates of the Pampa and of

(1) Dr. Adolfo Döring. Monograph transcribed in the work of Don Ricardo Napp «La República Argentina» p. 175.

(2) Mariano Barcena. La industria serícola en el Estado de Jalisco, 1891. México.

Santa Fé, assuredly the latter Province, considering its closer proximity to the tropic, is not the most suited for receiving immigrants from the temperate regions of Northern Europe, whose races are known to have the most robust constitution and greatest endurance for agricultural labour.

The close relation between climate and the ethnological and anthropological character of man has been thoroughly studied and summed up in an excellent book by Dr. Emilio Gouchon, in which the Argentine and foreign reader will find all the necessary points which should guide the selection and distribution of the European immigrant. (1) The learned naturalist Lorentz, professor in the University of Cordoba, quoted by Gouchon, speaks thus as to the climate of the Pampa.

« These lands could not be better. The Argentine Republic in them possesses boundless wealth and therewith a future which is not generally recognised. I am acquainted with a great part of North Germany and the Kingdom of Prussia. Every-one knows the part which this State has played in the history of these last centuries. How poor and sterile in great part are these lands, also consisting of extensive plains! »

« I have chosen this comparison, because the climates are similar, although that of the Argentine Pampa is milder: still they can perfectly well be compared. The impression which I have received in this journey has been most agreeable: I seemed to be living through the fairest days of the autumn of my native country. This is extremely important, because it is well known

(1) Emilio Gouchon. Apuntes sobre inmigración y colonización, Chapt II. p. 23 and follg.

that hot climates pull down and enervate man, rendering unavailable the greatest riches offered by nature; whereas the climate of this Pampa is admirably suited for a hard-working, industrial, intelligent and studious race of men. The lands could not be better adapted for a farming and pastoral population, and offer the basis for crowded and wealthy settlements. » (1)

Accordingly in the parallel which we are drawing, it is right to bear in mind that the climate and chemical properties of the soil are natural riches, in which the Pampa surpasses the Province of Santa Fè.

In addition to these advantages, there are others of an economic kind which at once strike the eye and scarcely require scientific demonstration.

The agricultural products of the Province of Santa Fè for the most part only find an outlet to Europe through the port of Rosario, and are burdened with great additions to freight and long delays owing to the obstacles presented to navigation by the passage of Martin Garcia island. This additional freight generally amounts to ten francs a ton, and imposes upon the maritime commerce of Rosario an annual tribute of more than 7 million dollars gold, or 21 million dollars papers at the exchange of 300 (2) whereas the products of the Central Pampa and the adjacent parts, when the lands have been colonised, will

(1) E. Gouchon p. 34.

(2) Memorial presented by the Rosario Chamber of Commerce to the National Government in 1891, showing the losses which Commerce suffered from the difficulties of the navigation of Martin Garcia. p. 16.

In 1895 the same Chamber of Commerce made a protest on the same subject. (Note by Señor Caffarena in the *Nacion* of Buenos Aires; Jan. 16, 1895.

not only find an outlet to the markets of Europe and of the Atlantic coasts—without the burden of intermediate freights—by the excellent port (not yet named) to be constructed in Brightman Bay, which will be the Southern terminus of the canal: but the markets of Chile will be also open to them, with an inexhaustible demand for live cattle and various other Argentine products, which will be exported by the Planchon pass, the Antuco or Picachon pass, the Cruz de Piedra and Tugarica passes, some of which passes will before long be traversed by railways (1) cutting the Central Pampa Canal at right angles.

In addition to all this one must also remember that Santa Fé possesses no mineral wealth of any kind which could be profitably worked so as in time to form the basis of manufacturing industries; whereas the territories of the Pampa, Neuquen and Colorado, and the South of Mendoza—as we have already described in Chapter I—abound in mineral wealth, especially fossilised coal and petroleum, throughout the whole Andine region. In order to prove this, it will suffice to transcribe here some paragraphs from the Report of the able and energetic Minister of the Interior in the year 1892 Dr. Zapata, who wrote thus: —

« Meantime the Republic has deposits of coal in many parts of the mountains which approach the Cordillera of the Andes. Many samples of this mineral have been tried in the capital of the Republic with satisfactory results, and quite recently a trial has been

(1) The inter-oceanic railway which will start from General Acha and take the direction of the Picochen Pass or Antuco valley, is an instance of this.

made on the Argentine Great Western Railway of *coal discovered in the Province of Mendoza, in the mining department of San Rafael*, a locomotive being driven with this fuel as far as La Paz.»

As regards petroleum, the same Minister, Dr. Zapata, says in this official document:—

« There are evident deposits of petroleum in Mendoza, Jujuy and Neuquen, and they must exist in many other places in the Republic » (1)

Lastly Santa Fè had to pass through difficult periods fraught with political disturbances; and was menaced by the Indians — so that the settler was obliged to carry his rifle as inseparable companion of all agricultural labour — before she saw her colonisation assured and reached the flourishing period of to-day.

The colonisation of the Central Pampa will not have to contend with any of these difficulties: there are no savage enemies to fight against.

The conquest of the Desert twenty years ago, is a decisive fact for civilisation: *The meaning of the word frontier*—as the famous General Roca expressed his aspirations in his message to Congress in 1878—*exists no longer, except with regard to foreign nations; since for the Argentine Republic there are no other Western or Southern frontiers than the Andine heights and the Ocean.* (2)

The Bill of Concession once sanctioned—then before eight years are past, great part of this vast territ-

(1) Zapata. Memoria del Ministerio del Interior 1892 p. 308.

Latzina;—Geografia Argentina p. 388. Provincia de Mendoza.

(2) Olascoaga. La Conqutsta del Desierto p. 34.

ory will be traversed by uninterrupted navigable ways; and abundant irrigation canals will spread fertility over an extensive emporium of settlements, which the present generation will see grow and become rich with all the gifts of science and labour.

A perfect system of title-deeds, based upon the legal and economic principles of the Torrens Act (The Real Property Act of Australia) (1) speedy transfer of property by way of endorsement, with easy and secure inscriptions in the great registration book of the Company (which will be the legal graphic record of the property duly surveyed and parcelled); and as the crown of all this scientific system of the distribution and guarantee of property, the protecting principles of the Homestead Act. (2), which preserve from embargo the settler's house and a portion of land (ten hectares,) sufficient to provide for the support of himself and his family—so as to preclude emigration and loss of population to the settlement: such are the advantages which constitute the superiority of the Central Pampa as compared with Santa Fé or any other part of the Republic, in addition to the mild and temperate climate, the admirable geographical position, the natural riches of this vast region and the easy communications with the interior which are proposed.

(1) A. Dain;—Le système Torrens, p. 11. Gallardo Martinez: El sistema de la Ley Torrens. Ruy Barbosa:—Systema Torrens, Exposição de Motivos.

(2) Corniquet; Le Homestead, Foyer insaisissable de famille p. 144. Homestead Act Sec. 4. March 20, 1862.

Bill of Concession. At 22.

Can it then be considered a rash or deceptive prophecy to calculate that the growth in value of this rich territory will follow the same geometrical progression as the Santa Fè lands, whose fabulous progress, due generally to the spontaneous action of the immigrant, we have amply described?

We do not reckon the value which speculation may give these lands when the echo of the movement on the canals resounds on the Stock Exchanges, and the lots are offered for sale with the same facility as a bill of exchange or Government Bonds: we will confine ourselves to that normal, gradual, economic growth which follows upon progress in settlement and the development of cultivation and traffic; that growth which the Company in its own interest must foster by means of an unimpeachable scientific administration. Can any-one consider it an exaggeration to affirm that within twenty years the lands of the Central Pampa will be selling *at least* for half the price which the Santa Fè lands have reached in thirty years?

Can any-one be ignorant that irrigation increases the value of the irrigated lands in a proportion which is never reached by dry lands? We need not seek examples from Europe to prove that a hectare of irrigated land is worth ten times more than a hectare without irrigation. (1) The Province adjacent to the Pampa, namely Mendoza,—which more than any other will reap the immediate benefits of the Canal, and see Azara's prophecy realised after a century—will supply us with a striking and decisive example of the value

(1) Laguna. Aguas y Riegos p. 12. Durant Claye. Hidráulica agrícola. Vol. 2 p. 548 and folly.

which the irrigated lands of the Pampa will attain, with the further advantage of a navigable canal for the commercial movement of its products.

In the year 1888, according to Latzina's Argentine Geography, the irrigated lands of Mendoza were worth \$300 a hectare at a distance of 10 kilometres from the city, \$200 at 15 kilometres, and at a greater distance about \$100. The lands irrigated by the River Tunuyan were worth \$100, and those irrigated by the Diamante \$60 (1) Señor Zeballos gives the value as much higher.

Accordingly in the arithmetical part of our work, in calculating the profits which the Company will receive from the enhanced value and sale of the canalised and irrigated lands, we might well take as the basis of value the last-named price, that is to say 60 dollars for the irrigated lands of the concession—without taking into account all the other natural, legal and economical advantages which we have stated.

But we will carry our moderation of estimate still farther and fix a selling price much lower than that of the Diamante lands, say 50 dollars for each hectare irrigated and having access to the canal: thus, taking as the basis of calculation the same 600,000 hectares which we took for our calculations in the preceding chapter, we get the following result:—

600,000 hectares at \$ 50 = \$ 30.000,000.

But 600,000 hectares are only two hundred and forty (240) kilometrical leagues.

(1) Latzina. Geografia p. 391.

Accordingly there would still remain for farming and pastoral settlement 1260 leagues at the disposal of the Company: these may gradually be sold at one-third of the price which we have seen the hectare fetches in Santa Fé or Buenos Aires, namely at the extremely low price of ten dollars the hectare—with good title-deed, proximity to the canals, and the option of future irrigation.

Deducting from this amount sixty leagues for villages, towns and commons, we get the following calculation:—1,200 leagues = 3,000,000 hectares at the lowest price of 10 dollars the hectare = \$ 30,000,000.

*
* *

Sixty leagues are 150,000 hectares, destined for building-lots in the towns and villages of the ports and canal-stations and for the common lands of the settlements. At 50 dollars, the lowest average price of the hectare, we get:—

150,000 hectares at 50 dollars = \$ 7,500,000

It is well to note that for all these sales we have fixed an uniform value for the whole sixty years of the concession, but it must be remembered that the value of land increases in direct proportion to all the economic factors which diminish the supply of land and improve the material and legal conditions of its tenure—such factors as increase of population, irrigation, improved communications, commercial progress and everything else which contributes to raise the demand above the supply.

Chapter VIII.

GENERAL SUMMARY OF THE THREE HEADS OF PROFIT.

Freights and transport during the 60 years of working	Paper dollars 180.000,000
Irrigation: \$3.360,000 a year for 50 years	168.000,000
Value of the 600,000 irrigated hectares at \$50 a hectare	30.000,000
Value of 1200 leagues (3 million hecta- res) at \$ 10 a hectare	30.000,000
Value of land set apart for building lots etc. (150,000 hectares at \$50, average value of the hectare)	7.500,000
<hr/>	
General Profits \$	415.500,000

As may be observed and as we have purposely determined, the net receipts from freight and transport have been put down at a sum even less than the estimate.

The profits of irrigation are only calculated from the end of a period of ten years, by which time the majority of the settlements, if not all, will be receiving this benefit: for, however rapidly colonisation be developed in the Central Pampa, it will take not less than