

are as bleak as the most barren parts of the Rocky mountains, and this sand and rock extend inland almost to the tops of the Andes. Along the coast there is a low range of foot hills rising in places to the height of a mile or more above the sea. Beyond this there is a rolling valley which runs from north to south, and on the other side of this valley the foot hills of the Andes begin. It is along the western edge of this valley that the nitrate is found. In some places it is not more than fifteen miles and in others as far as ninety miles from the sea, but the deposits lie along the western edge of the valley, forming a strip of an average width of about a mile and running irregularly, as I have said, from north to south for a distance of more than three hundred miles. In some places the deposit is four miles wide, and in others it plays out altogether and crops out some distance further on. In some fields the nitrate rock lies on the top of the ground. In others it is found from thirty to forty feet below the surface, with a strata of salt rock on top of it. The nitrate itself is seldom found pure in nature, though much of the rock contains from 40 to 60 per cent of nitrate, and other fields vary with the nature of the deposit. It is the getting the nitrate rock out of the earth and the extracting the pure nitrate salts from it that constitutes the immense industry of the pampas or nitrate fields. As to where the nitrate comes from there are a number of theories. One is that the desert was once the bed of an inland sea, and that the nitrate came from the decaying of the nitrogenous sea weed. Another theory is that the ammonia rising from the vast beds of guano on the islands off the coast was carried by the winds over the range of hills near the sea and there condensed, settled and united with other chemicals of the soil to form the deposits, and still a third is that the electrical discharges of the Andes, combine with the elements of the air to make nitric acid. This acid was carried down through the ages in the floods of the Andes, and was deposited on these beds in the form of nitrate of soda. None of these theories are entirely satisfactory, and as yet no one has absolutely solved the problem as to whence the nitrate comes.

We shall see how nitrate is mined by a visit to the great pampa at Tamrugal. This pampa or field has sixty miles of oficinas and nitrate fields. A railroad has been built through it to carry the nitrate to the seacoast at Iquique, and upon it has grown up vast factories, towns of corrugated iron huts, in which the tens of thousands of workmen employed in the business live and the homes of the scores of well-educated Europeans who live here and manage the properties. Leaving Iquique the railroad carries you up the hills and brings you right into the nitrate fields. You are soon in a plain about twenty miles wide with low hills rising upward on the right and the left. On the side of this plain nearest the sea the earth looks as though it had been plowed by giants, and it lies in mammoth clods of all shapes and sizes. This is the nitrate fields which have been or are being worked. The rest of the land is bleak, bare sand. There is no vegetation and no sign of life of any kind. All is sand, salt rock, and amid the clods nitrate rock which is called caliche. It is a soluble rock of different colors. In some places it is almost white and looks like rock salt. In others it is yellow, and in others all shades of gray, lemon, violet and green. The strata of nitrate usually lies two feet or more under the earth, and there is often a salt rock or conglomerate above it. The method of getting it out is to bore a round hole

about a foot in diameter through the upper crust and to extend it down for a few inches into the soft earth below it. Now into this hole a boy is let down. He scoops out a pocket for the blasting powder and arranges the fuse. He is then pulled out and the fuse is lighted. An explosion follows. A great yellow cloud of smoke and dust goes up into the air and the earth is broken up for a radius of about thirty feet about the hole. The nitrate rock is now dug off with picks and crowbars. It is broken into pieces of thirty pounds or less and is loaded upon iron carts to be taken to the factory. Each of these carts will hold three tons of rock and each is hauled by three mules, the driver sitting upon one of the animals.

The caliche or nitrate rock is taken in these carts from the fields to the oficina or factory. This usually stands in the midst of the fields. It is a collection of buildings with great smokestacks rising above them. It contains thousands of dollars worth of costly machinery, vast tanks for boiling the nitrate rock, crushers like those of a smelter to break it to pieces and settling vats in which the liquor containing the pure nitrate of soda is left until it has dropped its burden of valuable salt. The nitrate rock of the Agua Santa fields as we saw it blasted out of the earth has only about 40 per cent of nitrate of soda in it. The nitrate sent to the markets is from 95 to 96 per cent pure and the rock must be so treated as to bring about this result. This is done by boiling the rock just so much and no more. The crushers reduce the caliche to pieces about two inches thick, and it is then taken to the boiling tanks, which are situated in a building, perhaps fifty feet above the ground. These tanks are each big enough to form a bath tub for an elephant. They are twenty-four feet long, nine feet wide and eight feet deep. In them there are coils of pipe into which steam is running, raising the temperature of the fluid in the tank to any desired point. The caliche is carried in cars up an inclined railway and dumped into the tanks. Then water is admitted and is allowed to flow from tank to tank in such a way as to act to the best advantage on the salts within. The nitrate of soda will remain in solution at a lower temperature than other salts. This fact and others of a scientific nature are taken advantage of, everything being done with the greatest care, and the result is that when the liquor is drawn off nearly all of the pure nitrate of soda in the rock goes with it. It flows from the boiling tanks, which lie in the open air at a lower level. It now looks for all the world like pale maple molasses or thick lemon syrup. In a short time it begins to crystallize and the tank is half sugar, which is really almost pure nitrate of soda. This is now shoveled into piles, whence it is bagged up in sacks of 300 pounds each and hauled on the railroad to the seacoast to be shipped off to the United States or to Europe.

After the salts have settled in the tanks the liquor which lies on top still contains a large amount of nitrate. It is conveyed back to the boiling tanks and is loaded with ore nitrate by being flowed over the fresh rock. I shall not describe the technical details of the process, which is complicated in the extreme. They were explained to me by Mr. James T. Humberstone, the manager of the Agua Santa Oficina, the man who is perhaps of all the nitrate managers the best posted upon such matters. I will only say that the greatest care is taken to get every atom of nitrate out of the rock at the lowest possible cost, and that I was again and again surprised at the careful study which has been

taken to save every cent in product and labor throughout the works. It was indeed a lesson in economy, and when I referred to it Mr. Humberstone said: "The nitrate profits of today are a question of small savings. We make so much that the difference of a cent in the cost of a quintal, or 100 pounds, is an important item. It would, in fact, mean to us a saving of at least \$1,200 a month." Mr. Humberstone also showed me how the iodine of commerce is made from this nitrate liquor. It is an element separate and apart from the nitrate of soda and it forms another valuable product of the nitrate fields. It is precipitated in tanks by means of bisulphite of soda, and is drawn off in the shape of a dirty black powder. The powder is washed and filtered and is then put into iron retorts and heated. It soon turns to vapor, which is conducted into pipes of fire-clay, in which as it cools it changes into crystals of a beautiful violet color. These are packed up and shipped to our country and to Europe. The sale of iodine is a monopoly in the hands of Anthony Gibbs & Co. of London. The different companies have formed a trust which controls the product of the world and dictates just how much each factory may make every year. The price is now, I am told, 8 pence per ounce.

People who think that money is easily made in nitrate are much mistaken. The business requires large capital and the most careful management. The prices of nitrate lands have steadily risen of late years and today the only properties to be gotten outside of those in the hands of seventy-nine factories which are now in existence are from the Chilean government, which only sells at auctions, which are periodically held. The last auction was held in 1894, when 2,000 acres were appraised at \$3,500,000, and sold, I believe, for more than their appraisement. Another property was appraised at \$9,500,000 of our money. There is a limited demand for nitrate of soda, and while it is believed that the amount in sight will last the world at the present rate for fifty years and more, the Chilean government is anxious not to ruin the business out of which it gets so great a revenue by throwing more lands just now on the markets. Even after the land is bought it costs an enormous amount to establish a nitrate factory. Take that of Agua Santa. It has a capital of \$3,000,000 in gold, and it pays dividends of 10 per cent or \$300,000 a year. The factory alone cost \$655,000, and in addition there has been put in a Westinghouse electric plant at a cost of \$16,000 more. It has buildings which cost \$212,000, and its water supply cost \$51,000. It is now employing 800 hands, who receive \$60,000 a month, and it supports about the works a colony of more than 3,000 souls. It owns a railroad to the seaport of Caleta Buena, which port also belongs to it, and from which it ships its nitrate. Like all of the factories, it has a large store connected with the works and a great part of the wages of the men are spent upon the ground.

This is only one of the great establishments which the nitrate rock has built in a desert. It has built numerous other factories and it is now keeping tens of thousands of men at work. All along the nitrate railroad there are towns containing houses of corrugated iron, with hotels and stores, and at the seacoast, which is, if anything, more barren themselves, there are a number of thriving cities, all of which depend entirely upon these nitrate deposits. Take Iquique, for instance. It lies on the edge of the sea, right under the ragged hills which fringe the coast. There is not a blade of grass about it, and not a drop of water, save that which is brought here in ships or in the