THE WONDERFUL SULPHUR MINES OF LOUISIANA.

The extraordinary richness and extent of the mineral resources of the United States are proverbial, and all things considered, in the whole range of the mining industry it would be impossible to find a deposit which, relatively, in its richness and purity exceeds the sulphur mines of Louisiana. These are unique both in their geological formation and in the originality and daring of the methods adopted for the recovery of the metalloid.

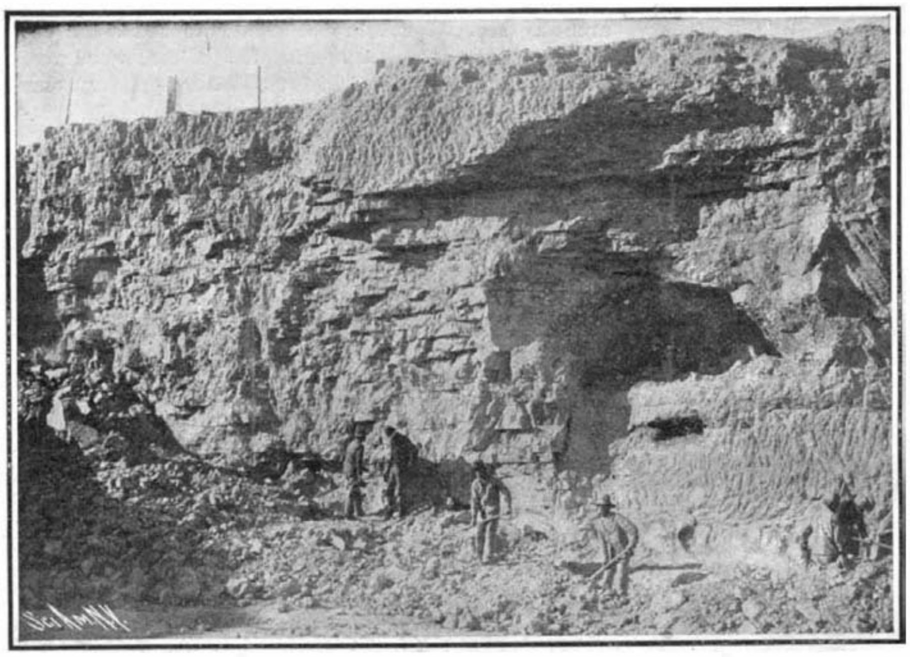
The deposits in question are situated near the little town of Lake Charles near the coast of the Gulf of Mexico, and close to the border between Louisiana and Texas. They belong to the Union Sulphur Company, to the untiring patience and inventive skill of whose president, Mr. Herman Frasch, is due the present ingenious and very successful method of recovery. Before proceeding to a description of this method, it is necessary to make clear the character of the deposits and the probable method of their formation. The large number of boreholes which have been sunk have revealed the presence, at great depth, of a vast extinct geyser, whose operations must have ceased far back in geological ages, the sulphur layers having been deposited in the tertiary age, either Eocene or Miocene. After passing down, first through 200 feet of clay and then through 200 feet of quicksand, and 80 feet of sand and gravel, the drills revealed the presence of a vast cone or mountain of limestone, approximately oval in form, the lip of the cone having a width of about 200 feet, and the mouth measuring from one-third to one mile across. A portion of the top of the cone is covered by a deposit of broken limestone, which varies in thickness from nothing to 150 feet, at the edges. After the drills had penetrated through this overlying stripping, they entered a huge deposit of sulphur and limestone, consisting of about 30 per cent of limestone and 70 per cent of pure sulphur. Below this was found a deposit of gypsum 450 feet in thickness, and underlying the gypsum is a deposit of salt. Surrounding and covering the walls and summit of this cone, with its valuable contents, is a bed of sand.

The discovery of this mine resulted from the efforts of a company which was formed in 1868 to search for petroleum, the presence of which was indicated by oozings from the surface of the ground. Two years later, attempts were made to extract the sulphur which the borings for petroleum had revealed; but the impossibility of controlling the abundant sub-surface waters of this region, which is almost at sea level, rendered all attempts to recover the sulphur by the ordinary mining methods abortive.

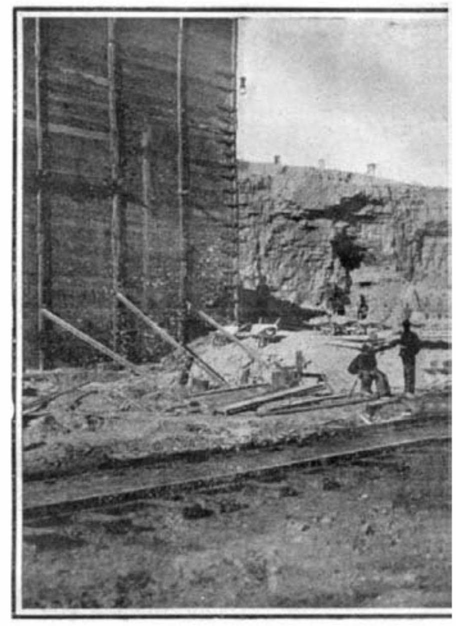
The present successful system may be said to date from the year 1891, when the first patents on a process for recovering sulphur by liquefaction were taken out; but it was not until the year 1895 that the inventor succeeded in securing the property containing this deposit, and not until seven years later that the many difficulties in the way of mining the sulphur in this novel manner were overcome and the process brought to a state of perfection which made the new method a financial success. The quality of the product of the Union Sulphur Company is excellent, showing upon analysis a purity of more than ninety-nine per cent.

Briefly stated, the sulphur is melted by means of superheated water which is forced down into the deposit through iron pipes. The melted sulphur, being insoluble in water, and of greater specific gravity, falls to the bottom of the well, whence it is raised to the surface by means of an air pump. On the surface it is allowed to congeal in the form of huge square masses, and subsequently is broken up and loaded on to the cars for shipment.

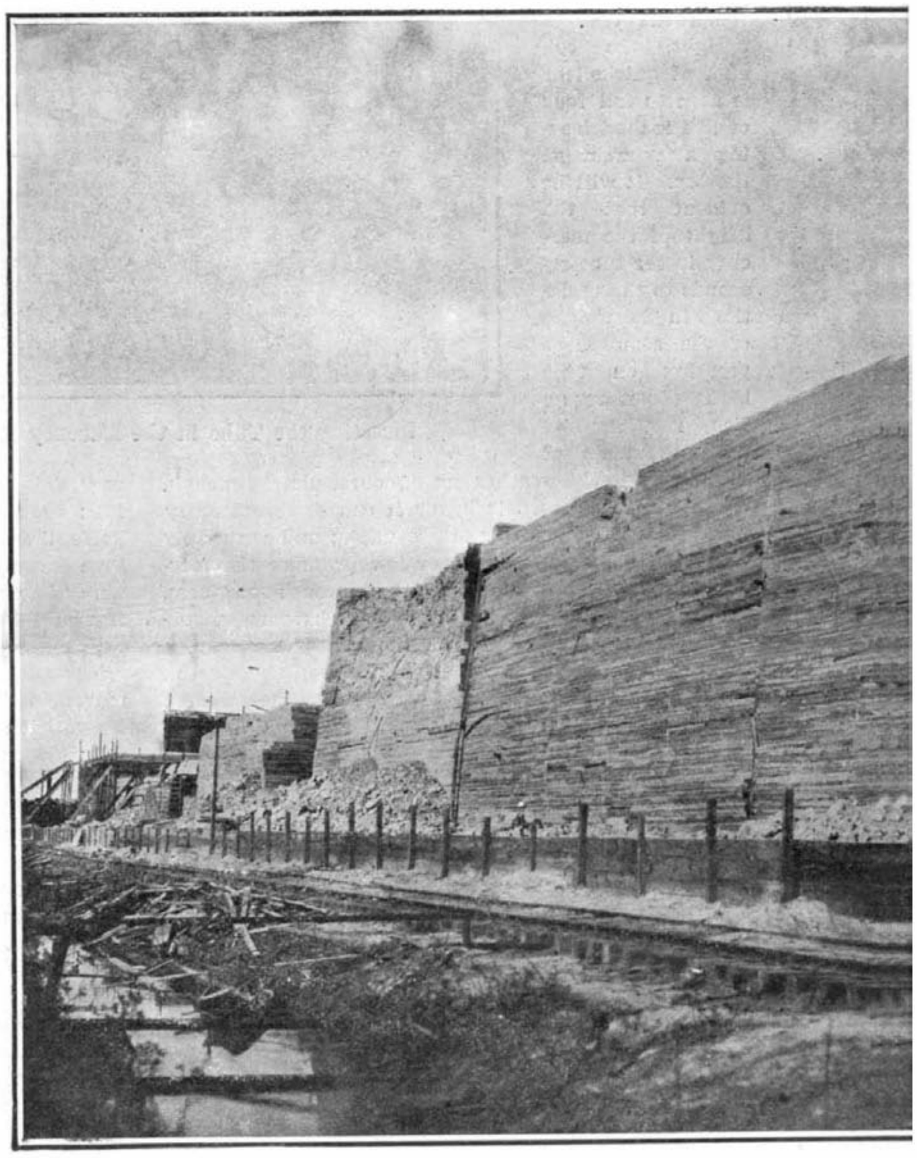
The details of the process are as follows: A well is drilled in much the same way as for petroleum, to the bottom of the sulphur bed. Down this well is run a system of pipes, one within the other, until it extends not quite to the bottom of the well. The outermost pipe is 10 inches in diameter; within this is a 6-inch pipe, inside of which is a 3-inch pipe, and within that a 1-inch pipe. Water, heated in a battery of boilers to a temperature of 335 deg. F., is forced down through the annular space between the 10-inch and the 6-inch pipes, and issues through a number of perforations in the side of the pipe at a point two or three feet above the bottom of the well. The water, because of its great heat and pressure, forces its way through the seams and crevices of the limestone rock, attacking and melting the sulphur, and causing it, because of its superior gravity, to drain down to the bottom of the well. Here it enters the bottom of the pipe through a number of perforations, and passes up through the annular space between the 6-inch pipe and the 3-inch pipe. Normally, the two columns of liquid, water and sulphur, would stand in equilibrium at different levels, whose height would be inversely as their respective specific gravities, the water column being twice as high as the liquid sulphur column; so that



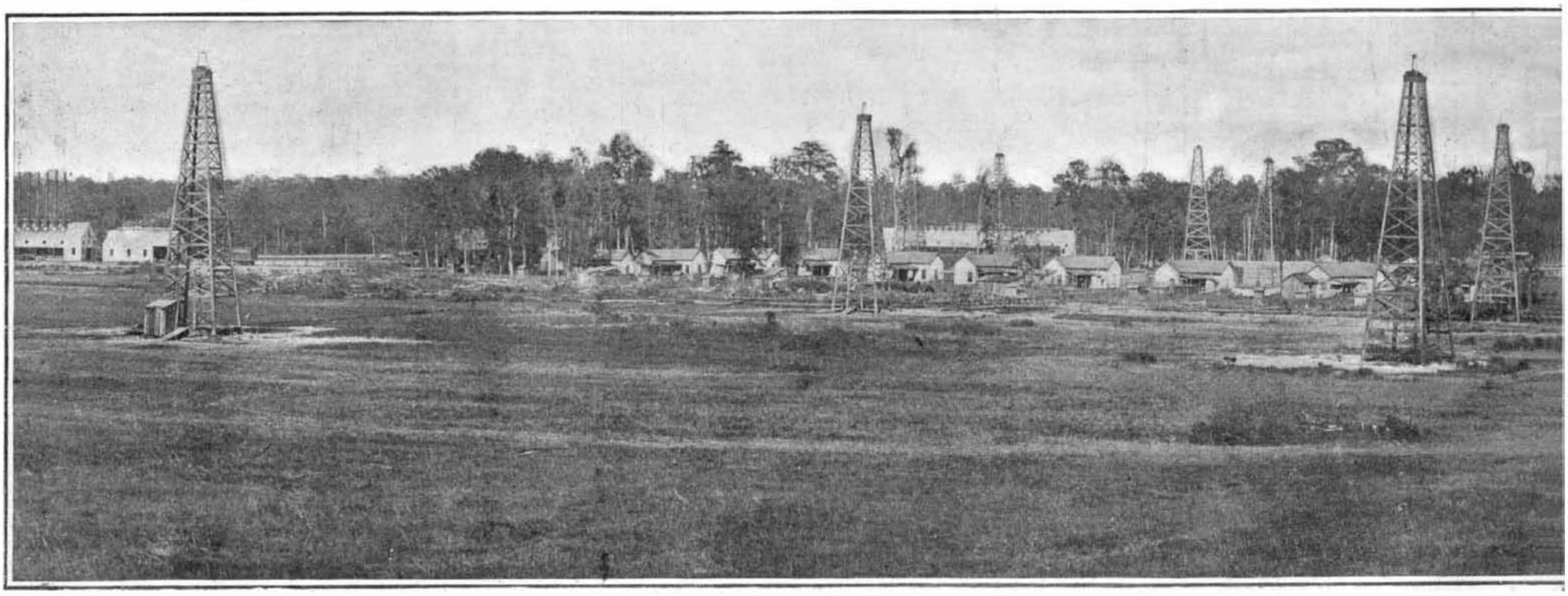
Wall of Sulphur, Showing a Pocket of Liquid Sulphur Long After Exterior of Mass Had Solidified.



Breaking Down and Lo



Solid Mass of Pure Sulphur, 40 Feet High, Af



Panoramic View of the Sulphur Recovery Works, Showing the Thi

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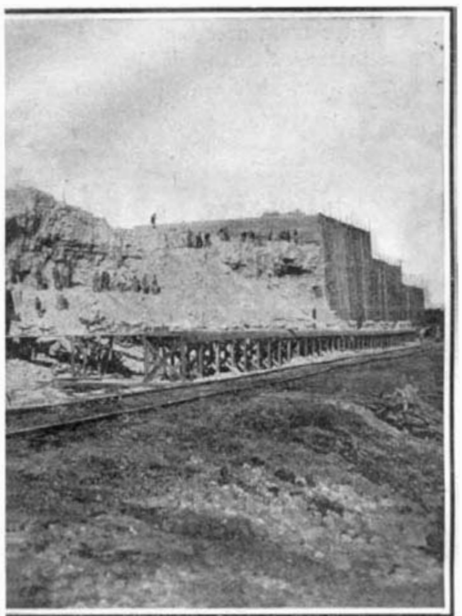
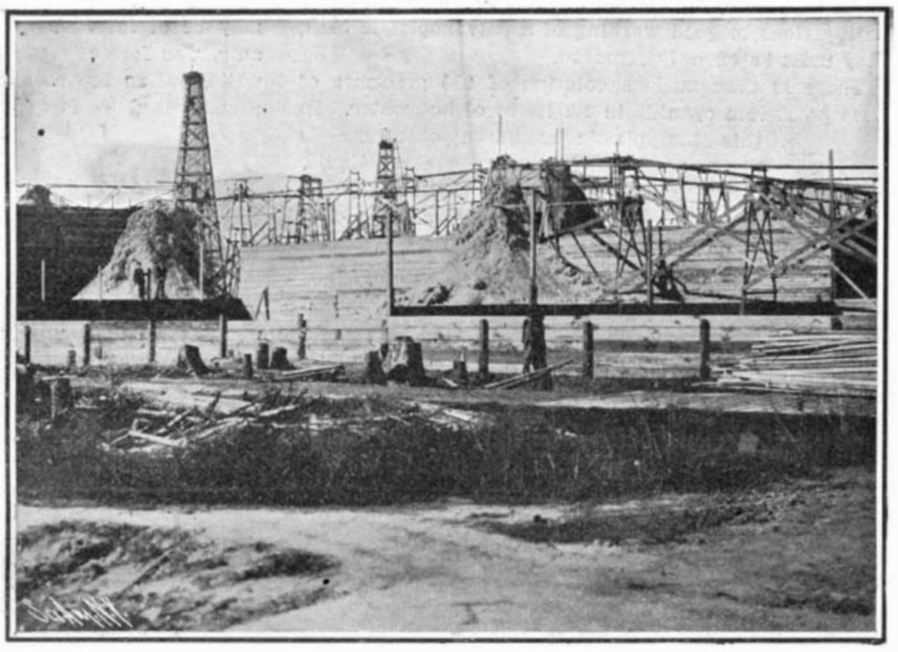
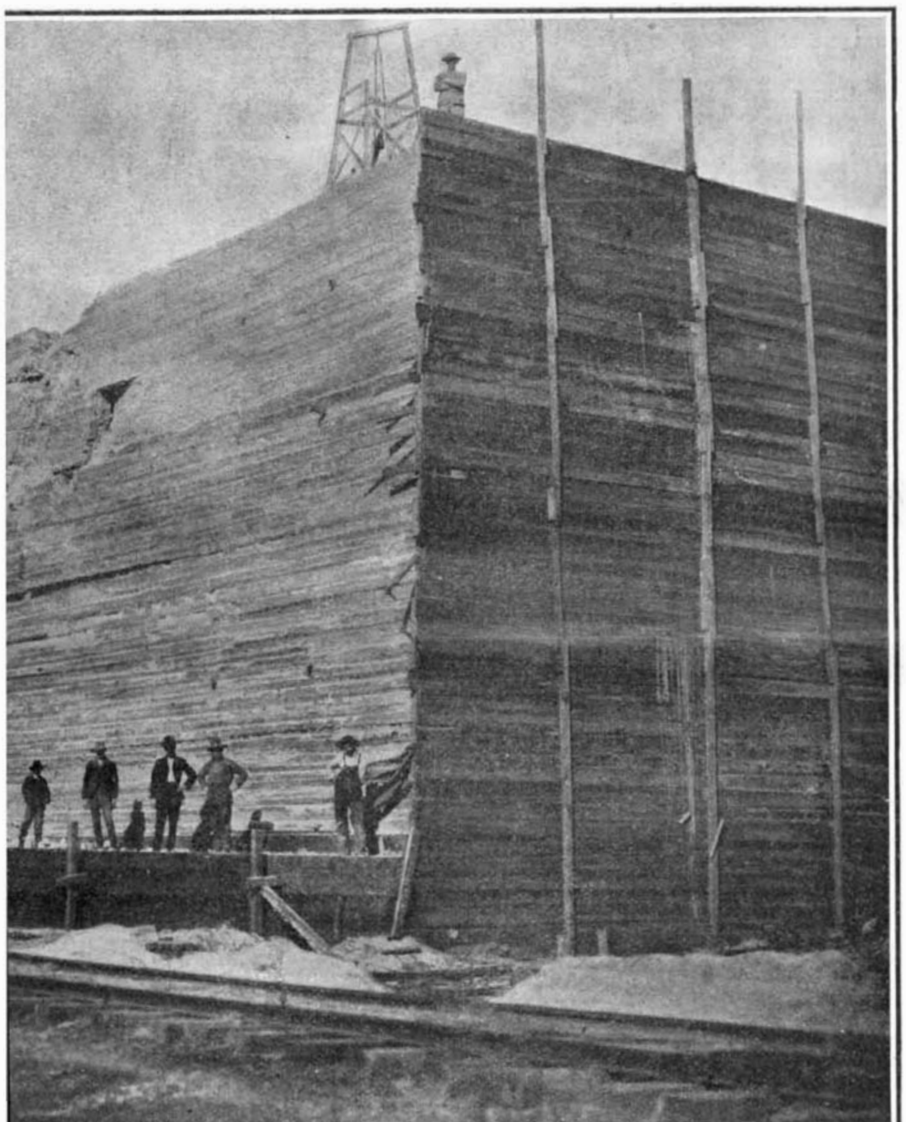


ading a Deposited Bin.



Three Wells Pumping Sulphur Into a Bin 250 Feet Wide by 350 Feet Long.



ter Wooden Walls of Bin Had Been Removed.

when the top of the water column was at the level of the ground, the top of the liquid sulphur column would be at a point halfway between the bottom and the top of the pipe. In order to bring the sulphur to the surface, compressed air is forced down through the 1-inch pipe into the liquid sulphur, and the density of the latter is thereby reduced, until it is less than that of the water, and the mixture of sulphur and air rises and flows out in a steady stream at the surface, as shown in one of our illustrations.

From what has been said above, it will be understood that the radius of action of the hot water, as it issues from the bottom of the tube, will be dependent upon its pressure and heat. That is to say, it will extend through the seams and fissures of the limestone rock, melting out the sulphur, just as far and just as long as it can maintain its heat above the melting point of the sulphur. As the sulphur, because of its greater specific gravity, drains away to the bottom of the well or pump, the water takes its place, although, of course, there is a gradual subsidence of the ground to fill the voids thus produced. From 400 to 500 tons of sulphur have been known to flow from a well in a single day, this rate being maintained for weeks at a time, and one well has actually furnished over 60,000 tons of sulphur. The wells are sunk at distances of from 50 to 100 feet from each other, and in this way this enormous deposit is being gradually exploited. The subsidence of the ground, as might well be imagined, is on a colossal scale, the surface having sunk over a large area to an average depth of 30 feet. The mere work of filling in this depression is no small task, hundreds of carloads of dirt having been hauled for this purpose.

Since the liquid sulphur comes to the surface over 99 per cent pure, it is not necessary to subject it to any treatment to prepare it for the market. Consequently, it is allowed to flow into large open bins built on the ground, areas measuring about 250 by 350 feet being bulkheaded in with timber for this purpose. The bins are of sufficient area to permit the layers to cool, as the sulphur flows into them, the layers forming and cooling first on one side of the bin and then on the other. In this manner a monolithic mass of pure sulphur, from 40 to 50 feet in height, is formed. The sulphur bins are intersected by tracks; and when a shipment is to be made, the boards surrounding the mass are taken down, and the wall of sulphur is broken up by laborers and wheeled into the cars.

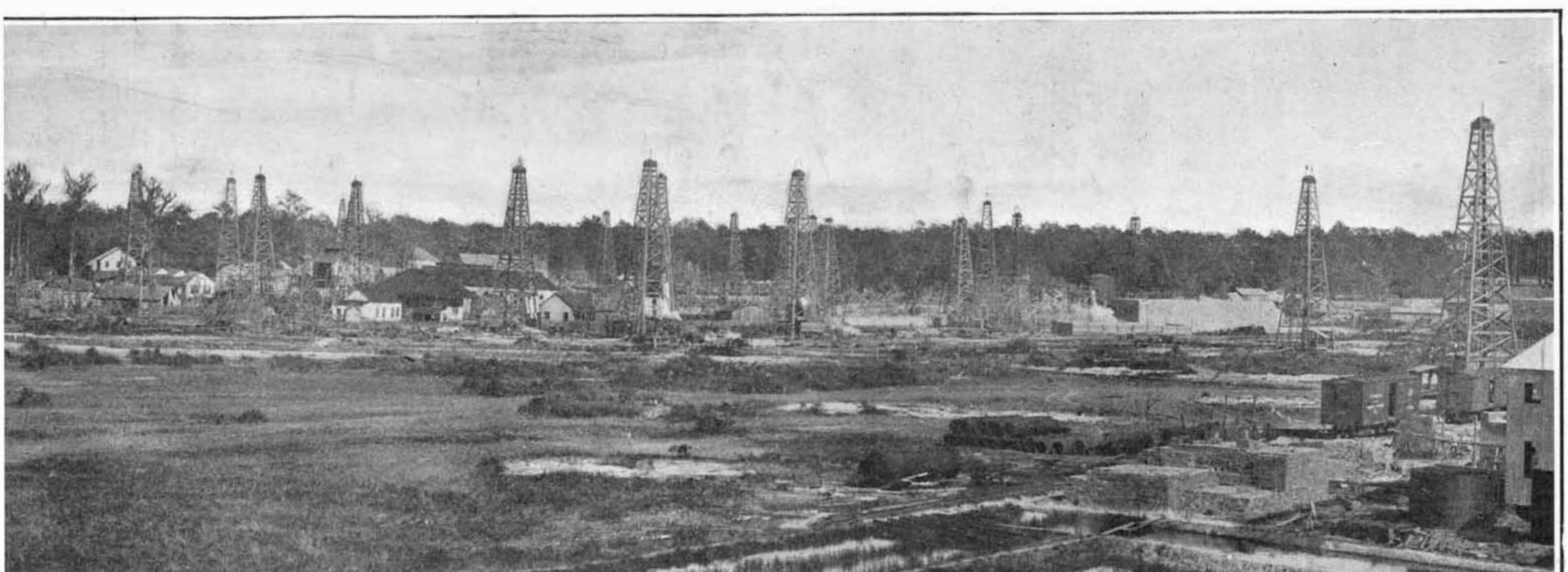
The illustration giving a general panoramic view of the plant shows thirty of the derricks by which the wells were driven, and several of the large boiler plants for producing the superheated water. Although the driving of the wells and putting down of the tubes is a large item of expense, the principal cost, of course, is the production of the enormous volumes of hot water, for which latter purpose a total of 24,000 horse-power of boilers is at the present time employed. Nevertheless, the sulphur rock is so extremely rich, the deposits of such vast extent, and the output so large and of such pure quality, that the Louisiana sulphur mines to-day are a great factor in the sulphur markets of the world. The annual consumption in the United States and Canada is about 200,000 long tons of elementary sulphur, and until the last few years the production of domestic sulphur averaged less than one per cent of the total consumption. In 1902 the domestic production of elementary sulphur was 7,433 long tons, and our importation 174,939 long tons. From these figures it can be easily seen that the United States, until very recently, has depended on Europe for the bulk of its sulphur supply. The successful development of the Louisiana mines, however, has put this country in a position to meet the entire domestic demand, and the Union Sulphur Company is in a position to place its product in the European markets in competition with the great sulphur mines of Sicily, which have hitherto been the main producers for the whole world.

Electroplating With Cadmium.

As cadmium can now be had at a reasonable price, it may be of interest, says a writer in the Deutsche Metallindustrie Zeitung, to know that there may be obtained an absolutely satisfactory plating therewith by galvanic deposition. Up to a recent date, however, attempts in this direction met with no success.

Cadmium is soft, has no caustic action, does not readily dim under the action of vapors containing sulphureted hydrogen, and its color is as white as that of tin, although not so white as that of silver. As compared with the latter metal, however, the galvanic deposit is harder and permits a higher polish.

Experiments show that for this purpose a solution of cadmium carbonate is best, and that the most favorable results may be obtained by the employment of such a solution. To make this latter, a solution of any soluble cadmium salt in water is treated with sodium carbonate. Cadmium salts are to be had in the



rty Derricks by Which the Pipes Are Sunk to the Sulphur Deposits.

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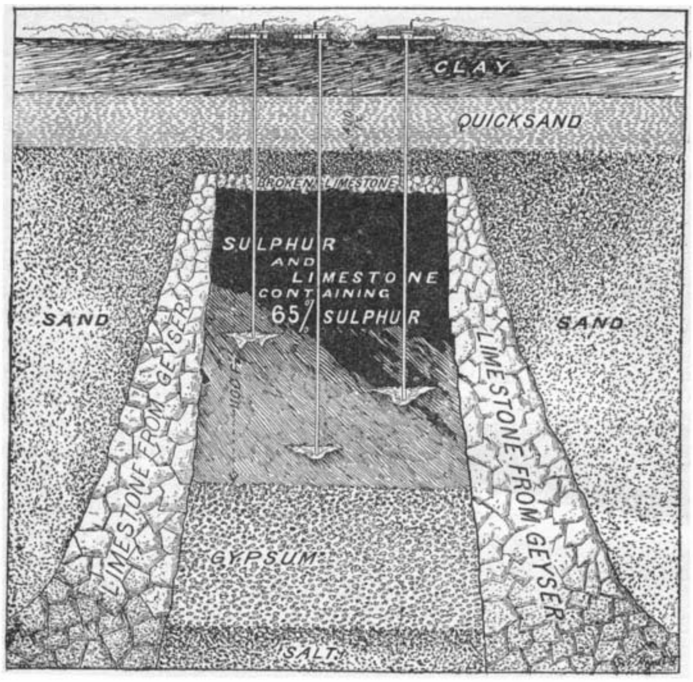
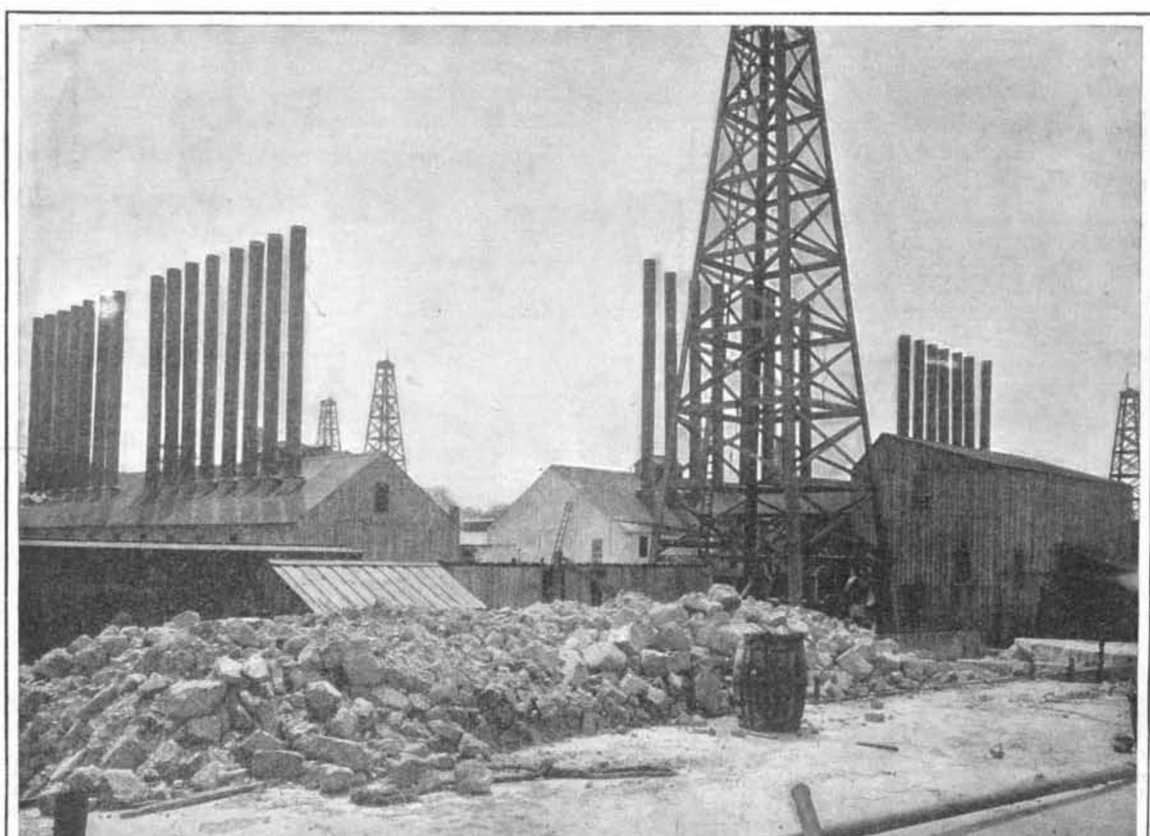
market, or one may make them from the metal. If the metal be used, the following process is employed: 85 grammes of metallic cadmium are dissolved in a mixture of 2,180 grammes of concentrated nitric acid and 10 of water in a glass or porcelain vessel. When



These deposits are contained within the mouth of an extinct geyser which in the course of geological ages was buried in sand, quicksand, and clay. The sulphur is melted out of the limestone rock by forcing down enormous volumes of superheated water, and then in the liquid state raised by compressed air to the surface.

Approximate Section Through the Sulphur Deposits of Louisiana.

all the metal is dissolved, 2.3 liters of water must be added and the whole heated to the boiling point. There is then made a solution of 453 grammes of sodium carbonate (washing soda) in 2.3 liters of hot water, and this solution is added in small quantities to that of the cadmium, while constantly stirring the mixture. There will be a white precipitate of cadmium carbonate. Sodium carbonate is added until no more cadmium carbonate is deposited. In this condition the solution will show an alkaline reaction. It is then allowed to settle; the white cadmium carbonate will rest



General View of a Small Part of the Wells and the Boiler Plant for Producing the Superheated Water.

on the bottom. The liquid above is to be decanted and thrown away. The vessel is now to be filled with hot water, and all well stirred and then let stand. The clear liquid should be poured off, and hot water again added. When the precipitate has settled and the liquid is decanted off the third time, the white cadmium carbonate which remains on the bottom of the vessel is washed five times with hot water and filtered. In order to thoroughly wash the precipitate, it is necessary to decant the liquid thoroughly therefrom before fresh water is added. If this is not done, the impurities remaining in the solution will only be diluted, not washed out. The object of the thorough washing is entire removal of the sodium nitrate formed as a precipitate; and as nitrates are well known to be injurious to good working of a galvanoplastic bath, they must be entirely removed.

There is then made a solution of 255 grammes of pure potassium cyanide in 1.2 liters of hot water. In this the plastic cadmium carbonate is dissolved, rapidly forming a clear liquid. The solution is next, by the addition of about 3.4 liters of water, brought up to about 4.5 liters, and is then ready for use. The proportions of the substances in the solution will be: Water, 4.5 liters; potassium cyanide, 255 grammes; cadmium, 85 grammes. The solution should show a density of about 8 deg. Baumé.

If necessary, there may be used instead of metallic cadmium, the chloride or the sulphate of the metal. This may be dissolved directly in water. They are then precipitated with washing soda, but a greater quantity thereof must be taken. Where the chloride is used, there must be employed about 170 grammes, as it contains only 50 per cent of cadmium. If the sulphate is employed, 595 grammes must be used, because this contains only about 1/7 its weight of metallic cadmium.

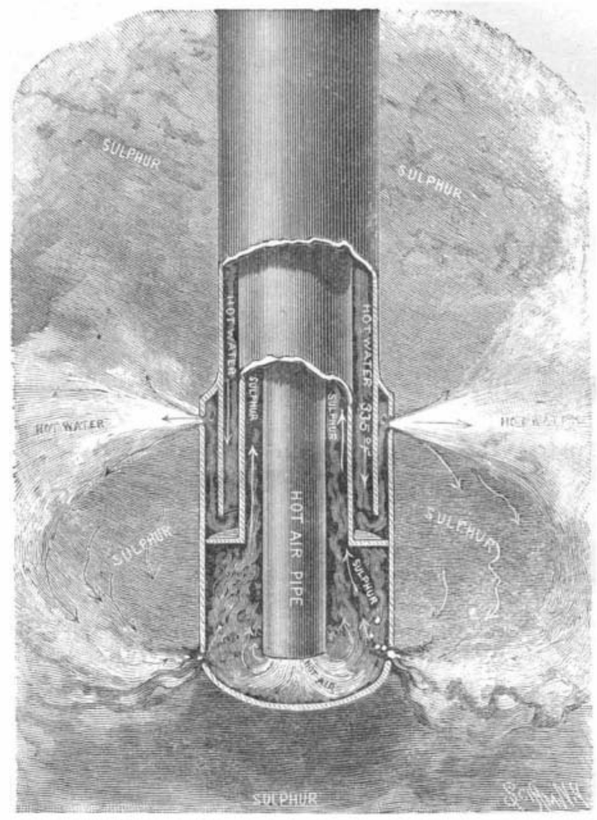
Commercial cadmium carbonate may be employed; but it has the disadvantage that it is not very soluble.

The cadmium bath, made according to the above formula, is clear and bright yellow in color. For the anode there is employed a cadmium plate. This can be made by melting cadmium and pouring it on an iron plate, or by rolling the metal into a sheet. Both the cast and the rolled anodes give good results.

When the above solution is used for electroplating, there may be obtained a faultless deposit with either a cold or a hot bath; but the brightest and firmest deposit is obtained when the temperature of the solution is between 50 deg. and 65 deg. C. (112 deg. and 149 deg. F.).

Novel Method of Conserving Storm Waters in Southern California.

At this time, when enormous sums are being expended for the storage of storm waters and the construction of various irrigation projects, the novel method of conserving storm waters in Southern California may be of interest. Pomona, a city of 8,000 inhabitants, was formerly supplied with water from artesian wells, but as the number of these increased, many of them ceased to flow, and pumping became necessary.



Section Through Bottom of Pipe of Sulphur Well.

Since that time many more wells have been sunk and pumping plants established, which caused the water level to fall, during the irrigating season, to 80 feet below the surface. A tunnel was driven nearly 7,000 feet into a gravel drift above the wells, until now the end of the tunnel is 125 feet below the surface. The water in the tunnel diminished as that in the wells lowered, even though a number of flowing wells were obtained in the bottom of the tunnel. Four years ago the winter flood waters from San Antonio Canyon, about four miles distant from the tunnel, were diverted from their course and spread over the rocky land above the head of the tunnel. A stream of several thousand inches, when "fanned out," disappeared within a few hundred yards and about two miles from the tunnel. The following September the water level in the wells below rose several feet, and the flow from the tunnel was materially increased. Title was then secured to 6,000 inches of storm waters, and each year the spreading of storm waters has been systematically carried on. The cost is small, two men doing the entire work. The water level, which falls as a result of pumping operations during the early summer months, has risen during September each year since storm waters have been spread. The average height of water in the wells has risen many feet, and the flow from the tunnel has increased to such an extent that the city now derives its entire domestic supply from that source. A number of wells are now flowing for the first time in ten years. This flooding begins usually in December and continues until May or June, depending on the amount of rainfall during the winter months.

The Pure Liquid Sulphur is Forced Up Through Pipes and Flows Into Huge Vats Where It Solidifies.

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