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AMERICAN SULPHUR.—HERMAN FRASCH.*

BY M. A. MANSBACH.

To start with, I am neither a scientist nor a chemist, and the excuse which I have for appearing before you consists mainly of the facts, first, that at the present time there is an extraordinary famine in sulphur; second, the revolution brought about in the winning of sulphur by that wonderful chemical and mechanical genius, Herman Frasch, is yet far too little known; and third, the Government states in the *United States Geological Survey Bulletin* No. 666B, that, as a preparedness measure, the sulphur deposits that are now idle should be thoroughly developed, search should be made for new deposits in areas where the geological conditions are similar to those in the vicinity of known deposits, and that other deposits of sulphite ores should be intensely developed.

Sulphuric acid, a government specialist has said, is probably used for a greater variety of purposes in the chemical arts than any other substance. It is made largely from sulphur. This acid and sulphur itself are employed in the manufacture of fertilizers, nitroglycerin, celluloid, powder, matches, fireworks, soap, paper, glass, starch, sugar, molasses, copper, galvanized iron, tin plate, artificial ice, effervescent drinks, shoe blacking, iron, steel, coke and medicine, for vulcanizing rubber, for bleaching wool and silk, for printing calico and tanning and for refining gold, silver and petroleum. It is surprising that no mention at all is made of the use of sulphur as a base for dyestuffs.

Previous to 1895 the method of producing sulphur consisted of digging for it in the same orthodox manner in which we are now digging for coal. This old method was found to be impracticable in this country owing to the great depth of the sulphur deposit, underlying a strata of oil-bearing quicksand. Losses of plants and hundreds of lives occurred until the Government intervened. Sicily at that time had quite a domineering position in the sulphur market. Sulphur is found in and near craters of volcanoes in Japan and Sicily. In Sicily, 35,000 men are employed in the winning of sulphur and this industry is of the greatest local importance. In 1833 sulphur was almost the cause of a war between England and Italy when an English fleet demonstrated in the Bay of Naples to compel Italy to rescind the sulphur monopoly granted to France. Sulphur is also found in Spain and Scandinavia, but not in sufficient quantities to compete with the Sicilian sulphur.

*An address before Scientific Section, A. Ph. A., Indianapolis meeting, 1917. The author was delayed and therefore it was impossible to illustrate the lecture; however pictures of the interior of the plant, sulphur deposits and pumps were shown; also samples of sulphur from the Louisiana, Texas and Nevada deposits.

In 1894–5, when another sulphur crisis threatened to break out in Sicily, the Anglo-Sicilian Company was formed. They controlled between 60 and 80 percent of the entire production and were thus able to pay a yearly dividend of 50 percent and to build up large resources for contingencies. This contingency arose very suddenly when it dawned upon the managers of the Anglo-Sicilian Company that it had to reckon with a new factor in the history of the sulphur production. That factor was Herman Frasch.

Now I might be pardoned to say a few words about this wonderful genius, who lived and was brought up in the same town as myself, who visited the same Latin school and gymnasium in the town of Halle. Soon after Herman Frasch came to America and entered the laboratory of Prof. Maisch at the Philadelphia College of Pharmacy. Industrial chemistry in the modern sense was at that time practically unknown and it was left to Herman Frasch's genius to work out the solution of many problems.

In 1874 he opened a laboratory on his own account and obtained his first patent in the same year on the method of using tin scrap profitably. When he was twenty-four years old, in the year 1876, he discovered the method of purifying paraffin wax. The patent was acquired by Mr. Rockefeller, and the candle and wax paper departments of the Standard Oil Company were the results. One of the most important inventions patented by Herman Frasch was one for the separation and treatment of oil. At that time Canadian oil was selling at $0.14 per barrel. It contained almost 1 percent of sulphur and had such an offensive odor that when a tanker laden with Canadian oil was lying in the port of New York, the food and butter stored in two adjacent steamers were entirely saturated with the same odor. Big lawsuits followed, and the production of oil in Canada had to be stopped.

Herman Frasch, in 1878, formed the Empire Oil Company, and at London, Ontario, solved the problem by a most wonderful chemical contrivance, introducing copper oxide that entirely absorbed the sulphur contained in the oil and made it as sweet and pure as the best Pennsylvania oil that sold at the time for $2.25 per barrel. Twenty additional patents were taken out in the years 1887 to 1894. In the meantime the Standard Oil Company had established large oil refineries in Ohio, going to very great expense. They treated the oil in the old orthodox way and the same was returned to them as utterly useless for lighting purposes. They had almost concluded a very large contract to build a pipe line to Chicago to sell oil for fuel purposes when Mr. Rockefeller heard of Frasch's desulphurizing process, which he bought after a thorough investigation. The Standard Oil Company bought the Empire Oil Company and Herman Frasch received shares of stock at 168, which was paying at the time 7 percent. When he had introduced his methods, he sold one-half of his holdings in the Standard Oil Company at 820. Ohio crude oil rose from $0.14 per barrel to $1.00 and above. The Standard Oil Company had made millions through this process and was able to raise the dividends from 7 to 40 percent and all the oil producers in Ohio, Illinois and Indiana were greatly benefited.

Among the many other very useful patents that Herman Frasch applied for, I will mention only one. In 1899, a patent was granted to him for an important process to bring to the surface by solution the rock salt reached by boring.

I mention this particularly because that same process has been used in my native town, Halle, Saxony, for hundreds and hundreds of years, and, in view of developments that took place one year later, I might be permitted to ask the question whether or not Frasch's early associations in the old "Salt City" of Halle were not responsible for the millions of dollars he was to make later? October 23, 1890, was the day which was to cause a revolution in the production of sulphur. Sulphur was discovered in Louisiana as long ago as 1865. Men boring for oil in Calcasieu Parish, La., found sulphur under a bed of quicksand several hundred feet thick. Repeated attempts were made to mine the sulphur, but without success. Engineers from France and Austria tried and failed. Herman Frasch heard of the deposit in 1891. He had already melted rock salt with water and had pumped it out of the ground into evaporating tanks. The same process, he thought, might be used in the Louisiana sulphur beds.

Having found and surveyed his golden treasure, Frasch began work on the problem of getting the sulphur out. A bed of quicksand 500 feet in thickness prevented the digging of a shaft. Besides, that method had been tried by others and all the casing had been lost. Moreover, Frasch was busy elsewhere. So several years passed, and then one day Frasch went to work in earnest. A well was driven, after nine months of labor, to the bottom of the deposit of sulphur. The well itself was a 10-inch pipe with perforations at the bottom. Inside that well were three pipes varying in size from one to six inches. In the meantime a battery of boilers had been located on the ground and special machinery invented by Frasch was attached to the boilers for the purpose of superheating great quantities of water.

Orders to fire the boilers were given one morning. When the water was heated to 335° F., Frasch turned it into the well. It ran out of the holes at the bottom of the 10-inch pipe, melting the sulphur, and twenty-four hours later, hot water still pouring in, the pump was started. The pump worked easily at first, but in a few minutes it "took hold" and presently a yellow stream came rushing out of the pipe. All the barrels were filled and then the sulphur was turned into a reservoir that had been hastily dug in the earth near by. The reservoir, too, was soon filled and the sulphur, hot but almost dry, was heaped up until it made a yellow hill. The day drawing to a close, Herman Frasch stopped the machinery and, climbing to the top of the hill, sat down in the sulphur and let it stream through the fingers of his open hand.

He bought the property and organized the company in 1894. It was not until 1903, however, that he obtained sulphur in paying quantities. He brought in 35,000 tons that year. In 1904, he had enough to supply the American market and to ship a cargo of 3,000 tons to France. In 1903, the imports of sulphur into the U. S. were 188,888 tons, the exports none. In 1907, the imports were 20,399 tons, the exports 35,000 tons. The production of sulphur in the U. S. during the year 1880 amounted to 536 tons and the price was $39.00 a ton. In 1904, the first big year of the Louisiana mine, the production was 128,000 tons; in 1911, 768,000 tons; in 1917, estimated requirements, 1,500,000 tons (600,000 tons short of production).

Government figures give the production of 1914 as having been 328,000 tons and practically all of it came from the southern swamp that Herman Frasch pur-

chased in 1894. At the beginning of his enterprise Frasch had introduced John D. Rockefeller's brother into his company, but, during the long years of hard and unsuccessful work and the beginning of the mine, Rockefeller lost heart and sold his interest out, thereby throwing away a yearly income of between $250,000 and $500,000. The real extent of Herman Frasch's wealth did not become known until after his death in Paris. His friends had always thought him a fairly wealthy man, but were amazed at the sensational figures of his millions which were disclosed afterward.

THE HISTOLOGY OF CASTELA NICHOLSONI.

BY C. J. ZUFALL.

Castela Nicholsoni is known in America as *Chaparra Amargosa* (Mexican for "bitter bush") and on the Island of Antigua as "Goatbush." This drug, although not widely known, is of considerable importance in the Southwest where it is employed in the treatment of amebic dysentery. One physician[1] states, "it is the most efficient remedy we have at the present for the treatment of this disease, unless we except emetine."

In 1883 J. L. Putegnat[2] made a brief study of the drug but did not describe the plant fully or give its histology. He determined the percent of extractives with various solvents and briefly studied the bitter amorphous principle, to which his father, J. L. Putegnat, had given the name "amargosin."

Hooker[3] first described the plant, a specimen of which was sent him by Dr. Nicholson of Antigua. Determining that it belonged to the family Simarubaceae and the genus *Castela*, but finding it not to conform to the descriptions of the known two species of *Castela*, he placed it as a new species and called it *Castela Nicholsoni* in honor of Dr. Nicholson.

The following is a translation of Hooker's description of *Castela Nicholsoni*:[3]

The main stem or trunk not exceeding four feet, much branched; branches provided with short axillary spines; small branches terete, silky-hoary. Leaves evergreen, alternate, sparse, in scattered groups, sessile, coriaceous, elliptical, mucronate, silky-gray beneath and margin revolute.

Flowers small, saffron- or orange-colored, dioecious. Peduncle axillary, short, one- or two-flowered.

Staminate flowers:—Calyx four-parted nearly to the base, segments ovate, variegated, persistent. Petals: four, ovate, spreading, deciduous. Stamens: eight, short, hairy, inserted on the fleshy receptacle. Anthers oblong, divided or sagitate and yellow.

Pistillate flowers:—Calyx and corolla, same as in staminate flowers. Ovules: four, contiguous, one or two frequently abortive. Style short or none. Stigmas: four, small, and subulate. Stamens: eight, short, abortive, hirsute and adherent. Drupes: four, subglobose, base acuminate or short pedicelled, small, purple or red when mature. Nut compressed, ovate, bivalved, rugose, unilocular. Seeds suspended, sub-ovate, compressed. Albumen small, thin, flesh-colored. Embryo almost as large as the seed. Cotyledons straight, foliaceous.

Dr. Nicholson observes that "it is a beautiful little shrub, especially when in fruit. It is found growing in the utmost luxuriance in an arid calcareous soil where everything else is burnt up."[3]

In America it is found in "southwest Texas and northern Mexico growing on thin, rocky, mesquite or post-oak land, and having an especial tendency to be found on small rocky hills."[1]