plished in less than two hours. After boiling three quarters of an hour, it is well to begin the iodine tests, and after it is ripe for sirup, to continue the operation some time longer, until, on cooling, sugar will readily crystallize. It is one thing to make sirup, and another to produce sugar, the proportions of acid and the time being different in each case.

After shutting off the steam and suspending the boiling, 15 pounds of bone black must be strewn in, and the liquid set to boil for five minutes. It is then ready to run into the neutralizing vats.

After neutralization, 30 pounds of bone black must be added, under constant agitation, and 15 pounds sulphurous acid and one pound crystallized soda, as before, and the whole left 6 to 8 hours to settle. The clear sweet liquid can be introduced into the vacuum apparatus for concentration. It can be boiled down in open vessels by steam, but is not so white and pure as when the vacuum pan is employed. As soon as the sirup shows 36°, it is filtered, and run into suitable crystallizing vessels. On the filter will be collected the gypsum produced by the neutralization; and as it contains considerable sugar, it must be pressed out and washed. In Germany, the filter consists of strong cloth placed inside of a conical basket, fitted to a suitable barrel. The liquid runs through perfectly clear, and requires three or four days for its crystallization; to hasten the crystallization, some farina sugar can be stirred in. When nearly dry, it is poured into boxes of a suitable size for transportation. The solid grape sugar is extensively employed in breweries, in the manufacture of wines, for distillation, and in candy. The price of the sugar is higher than for sirup, and it is not liable to deteriorate, if it be properly prepared.

The form of the boiler has been considerably modified. Instead of performing the reduction by steam under pressure, a coil of copper pipe, in the bottom of the wooden vessels, serves to convey the heat for boiling the mixture. The dilution of the liquid by the condensation of the steam in the vat, and the necessity of boilers that could resist several atmospheres of pressure, are avoided. There is also less liability to explosion. The employment of nitric acid is a new feature, and the use of sulphurous acid, for the double purpose of bleaching the sirup and preventing fermentation, ought not to be overlooked.

Pure starch sirup resembles honey so closely that few could detect any difference. It is fast becoming a substitute for molasses and sirup from cane, and as the syrup resulting from the beet root sugar is only suited to fermentation and the recovery of potash, the starch sirup must fast grow in favor.

Grape sugar can also be made from shavings, rags, saw dust, and any kind of cellulose, but the cheapest material is the starch from corn and grain. To insure a good quality, attention must be paid to removing all traces of the lime and soda used in neutralizing, and to a proper bleaching by bone black and sulphurous acid. With these precautions, and by aid of improved machinery, there is no reason why the industry should not be made a profitable one to all who are disposed to invest in it.

## SULPHUR IN LOUISIANA.

Sulphur beds of great extent, remarkable purity, and apparently of immense value, were discovered accidentally, some three years ago, in the parish of Calcasieu, southeastern corner of Louisiana, near the Calcasieu river, a navigable steam emptying into the lake of the same name, which communicates with the gulf; the mines are not far distant from the line of the Chattanooga railroad. The discovery was made during the boring of a well for petroleum. Oil in paying quantities was not found, but something better, in the shape of this sulphur bed. From a recent pamphlet issued by the American Sulphur Mining Company, of New Orleans, we gather the interesting particulars which follow.

This company (having a capital stock of $600,000) and the Calcasieu Sulphur Mining Company are at work in the development of the sulphurous treasures, and the indications are that this country will ere long cease to be an importer and become an exporter of this valuable commodity.

The Louisiana bed, or layer of sulphur, commences at a depth of 428 feet from the surface of the ground, and terminates at 540 feet, the bed having thus a thickness of 112 feet. The proportion of sulphur is 60 per cent at the top of the bed, the proportion increasing rapidly as we descend, being 90 per cent at a depth of 486 feet. The proportion then gradually diminishes.

The sulphur appears in compact and amorphous masses, of a pale color, interspersed, here and there, with yellow crystals. It is surrounded by a calcareous, crystalline matrix, of whitish color, and rather considerable hardness, but which, nevertheless, is easily reduced to powder under the stroke of the hammer. The general analysis of the deposit yields 77 per cent of pure sulphur.

As for the working of the sulphur bed itself, it will not present the slightest difficulty; for the rock, without being too hard to disintegrate, is yet sufficiently compact and resisting to sustain, without any wooden scaffolding or coating, all the galleries to be constructed.

### HOW SULPHUR IS MINED IN SICILY.

In Sicily, pre-eminently a sulphur producing country, the art of working mines is yet in its infancy.

The sulphur strata are met at average depths of 120 to 150 feet below the surface, and are reached by means of sloping galleries, supplied with steps dug in the soil itself.

All the mineral extracted by the miners is brought up to light by children from twelve to sixteen years of age. They take upon their shoulders one or two stones, which they bring up with much trouble to the surface, after overcoming untold obstacles in ascending the steps, always roughly made and partly crumbling. Having reached daylight, they lay down their load, and at once descend again to the bottom of the mine to repeat the same operation.

The proportion of sulphur in the mineral is from 20 to 30 per cent, or an average of 25 per cent. Of this 25 per cent, the Sicilians scarcely extract from 10 to 14 per cent of sulphur; for, owing to the lack of fuel, they are compelled to use the sulphur itself to operate the melting; in other words to burn one half in order to melt the other half, obtaining thereby a very impure product, which has to be manipulated again and refined before being delivered for consumption.

Last year, we published in the SCIENTIFIC AMERICAN an account of the sulphur mines of California, at Clear Lake, which are being worked to great advantage, and are capable of more than supplying all the sulphur needed on the Pacific Coast. The Clear Lake mineral contains fifty per cent of pure sulphur. It is, therefore, not so rich as the Louisiana deposits.

## COAL TAR PRODUCTS.

Mr. Anthon Pubetz, director of extensive dye works in Bohemia, has published a short review of the preparation and properties of the principal coal tar products, from which we gather some important facts. Among the thirty-five bodies, partly solid, partly liquid, which are found in the tar, only five, namely: benzine, tuluene, naphthalin, carbolic acid, and cresylic acid are of much importance in the arts.

### BENZINE.

Benzine is a light, mobile, colorless liquid, very volatile, and possessing, when pure, an agreeable odor. Its specific gravity is 0·85. It freezes at 0° C, and boils at 80° C.; is insoluble in water but soluble in wood spirit, alcohol, ether, or acetone. It dissolves small quantities of sulphur, phosphorus, iodine, shellac, and copal; and dissolves readily the fats, etherial oils, camphor, wax, india-rubber, gutta-percha, quinine, morphine, strychnine, but not cinchonine. From benzine are prepared a large number of acids, and nitrogen, chlorine, and bromine compounds.

### TULUEN, OR TOLUOL.

By the fractional distillation of coal tar we obtain an oily, mobile, volatile liquid, specific gravity, 0·87, and boiling at 110° to 111° C. It odor resembles benzine, it is insoluble in water, slightly soluble in alcohol, but easily soluble in ether. There are numerous products of its decomposition, as of benzine.

### NAPHTHALIN.

Naphthalin is one of the principal constituents of coal tar. It is solid at ordinary temperature, fuses at 79° C., boils at 220° C.; and its specific gravity is 1·048. It can be easily sublimed into thin, white, rhombic scales of tarry odor and aromatic taste. Impure naphthalin turns brown in the air. It crystallizes, from its solution in ether, in large prisms, which remain unaltered in the air. It can be ignited with difficulty, and burns with a smoky flame, even in pure oxygen. Water does not dissolve it, but it is very soluble in alcohol, ether, in the fat and essential oils. It is used as a substitute for camphor in the destruction of moths, and also in the preparation of colors.

### CARBOLIC ACID.

Carbolic acid crystallizes in long, colorless needles, possessing a penetrating odor resembling creosote. Chemically pure carbolic acid, entirely free from cresylic acid, fuses at 41° C., and boils at 182° C. Its specific gravity is 1·065. It does not turn blue litmus red, and, when ignited, burns with a smoky flame. Water only dissolves two per cent of carbolic acid. Alcohol and ether dissolve it in all proportions. It is also soluble in acetic acid, in the carbonate and caustic alkalies, and does not enter into combination with ammonia. Solutions of carbolic acid coagulate albumen and destroy insects. It is used for the preservation of animal matter, and as a disinfectant. A pine shaving, previously moistened with hydrochloric acid, is changed by carbolic acid to a beautiful blue color on exposure to the sunlight. A numerous class of bodies has been prepared from it by chemists, and it is now extensively employed in the arts.

### CRESYLIC ACID.

Cresylic acid is constantly associated with carbolic acid, and it is very difficult to separate them. It is a transparent oil, possessing a smoky odor, with a bitter, burning, caustic taste. Its specific gravity is 1·037 to 1·04; it boils at 203° C., remains liquid at 27° C., and in other respects closely resembles carbolic acid.

### NITRO-BENZINE.

Nitro-benzine, called also nitro-benzole and essence of mirbane, is a yellow liquid, possessing a sweet taste, and the odor of bitter almonds. It is used in perfumery instead of bitter almonds, but its chief consumption is in the preparation of aniline. It is insoluble in water, but can be mixed in all proportions with alcohol and ether. It freezes at —3° C., in crystalline needles, boils at 213° C., and can be sublimed unchanged. It is easily manufactured by the action of nitric acid upon benzine. A similar compound is made by the action of nitric acid on toluol, from which aniline can be prepared.

### ANILINE.

Aniline was discovered in 1826, in the distillation of indigo. It is now almost universally prepared by the deoxidation of nitro-benzole, by means of nascent hydrogen evolved by iron filings and acetic acid. Aniline is a colorless, oily liquid, which turns brown in the light, possessing a vinous aromatic odor, and a bitter, burning taste. Its specific gravity is 1·028. It is slightly soluble in water, but is dissolved in all proportions in alcohol, ether, or fatty oils. It remains liquid at 20° C., boils at 182° C., and combines with acids to form crystallizable salts, which are soluble in water and alcohol. The faintest trace of aniline can be detected by the deep purple violet color which it imparts to a solution of bleaching powders.

Aniline and the solutions of its salts color oak wood an intense yellow. Aniline is said to be the only poison the salts of which are not also poisons. Aniline salts are innocuous; they stain the skin, nails, and mouth violet, but the color soon disappears. Aniline itself is a violent poison, and must be handled with care. The principal salts of aniline are the chloride, sulphate, nitrate, phosphate, and oxalate, some of which are used in the preparation of colors.

### ROSANILINE.

In 1862, Professor Hofmann isolated the base rosaniline in the form of small white crystals, which rapidly turn red in the air by the absorption of carbonic acid. Heated to 130° C. it is decomposed into aniline and carbon. Rosaniline is prepared by the action of chloride of zinc, also arsenious acid on aniline containing toluidine. Combined with acids, it yields salts which have a metallic luster, and are extensively employed in dyeing under various trade names, such as fuchsin, azalein, magenta, solferino, imperial ruby, rosein, anilein, rouge, and neuroth.

### HOFMANN'S VIOLET.

Hofmann's violet differs from rosaniline in containing more carbon and hydrogen. It is prepared by heating together equal parts of iodide of ethyl, rosaniline, and caustic soda, and dissolving the product in ten or fifteen parts of alcohol. The special value of this color is that it is a pure violet, without a red or blue tinge. It is one of the most highly prized of the aniline products. There are other colors which have been added from time to time, a detailed account of which can be sought in recent works on dyeing. They are Perkins' violet, geranosine, cyanine, picric acid, corallin, and azulin. The order of discovery of the aniline colors is said to be as follows:

| | | | |
|---|---|---|---|
| Aniline purple | discovered | in | 1856 |
| " magenta | " | " | 1859 |
| " blue | " | " | 1861 |
| Hofmann's violet | " | " | 1863 |
| Britannia violet | " | " | 1865 |

It is estimated that 10,000 pounds of aniline oil are manufactured daily in Europe, to be converted into the various dyes mentioned above. Such is the unprecedented growth of an industry that had no existence fifteen years ago.

## MANUFACTURE OF SILK.---SILK WORM EGGS.

Although, for many years, the manufacture of sewing silk has been one of the recognized industries of this country, still it is only within the past five years that the silk manufacture has assumed any very important proportions. It is now rapidly extending, and ere long the United States will occupy a leading place in the supply of every description of silk goods.

In Paterson, N. J., there are some thirty establishments for manufacturing silk, employing about six hundred persons, and making nearly all kinds of goods. Of ribbon factories, the largest in the United States are there, two of them employing from three to four hundred hands, though the leading specialty is silk dress goods, chiefly blacks. A large business is also done in pongee silks, or handkerchiefs, which are sold plain to New York merchants, by whom they are sent to various print works on Staten Island for a finish.

Most noticeable of all, is the large establishment of the Dale Manufacturing Company, engaged in serges, braids, cords, dress trimmings, etc., in great variety. This concern, like others, does a heavy business in manufacturing trams and organzines (warp and filling) for silk establishments throughout the country. Another factory employs numerous hands exclusively on ladies' trimmings, gimps, and fringes. Several others are making sewing silk, hat bands, etc.

To show the importance acquired by some of these minor items, we may state that a single small concern in New York city consumes weekly hundreds of pounds of silk in making the tiny tassels for umbrellas.

Mention might be made of the large works of the Cheney Manufacturing Company, near Hartford, Conn., which is said to turn out stuff to the amount of two or three million dollars per annum.

At Hoboken is another factory, for weaving, and in Massachusetts and Connecticut there are various concerns which have been making silks and twists for the last twenty years.

Enough has been said to show that the silk manufacturing interest is having a rapid development. This appears from the simple statement that five years ago, within a radius of fifty miles of New York, there were not fifty looms running on broad silk. Today, there are not less than 1,000 in New Jersey alone, and in Connecticut and other places, 2,000 or 3,000 more—among these one at Green Point, L. I., should be included. The direct importation of raw silk overland from China and Japan, brings the crop quickly into market, which is a decided advantage.

The importation of silk worm eggs from Japan appears to have already reached a considerable magnitude. A shipment of 100 boxes of eggs, valued at half a million of dollars, lately arrived at San Francisco. They were to go by rail to New York, thence to France, Italy, and Turkey.

OFFICIAL reports from India, state that the coal fields in the district of Berar are much more extensive than had been supposed, and are at a moderate depth below the surface. In one place, a bed of coal, more than thirty feet thick, was struck at a depth of not more than seventy-seven feet. The Damuda field has an area of 149 miles, with an average thickness of forty feet. And in other districts, beds of iron ore from nine feet to seventeen feet thick have been discovered.