STEVENS INSTITUTE LECTURES.---DYEING AND CALICO PRINTING.

BY PROFESSOR CHARLES F. CHANDLER.

The fourth lecture of the spring course before the Stevens Institute of Technology was by Professor Charles F. Chandler, of Columbia College, New York city, on "Dyeing and Calico Printing." He said: The materials of which our clothing is made,and with which the dyer has to do, are cotton, linen, wool and silk, the first two derived from the vegetable and the last two from the animal kingdom. They occur mixed with various impurities, which are more or less colored and must be got rid of so as not to impair the clearness of the colors in which they are subsequently dyed. They are subjected to the alternate action of dilute alkalies and acids and afterwards bleached by means of chlorine or sulphurous acid. Formerly the linen goods were bleached by being moistened and exposed to the sun. The Dutch were especially noted for their success in this industry. Goods were sent from other countries to Holland to be bleached, and hence the name "Hollands" to designate the material used in the manufacture of window shades. The application of chlorine to bleaching put an end to this trade.

Dyes are fastened upon fabrics in various ways. Some are insoluble in water but soluble in other substances. If cotton is dipped in a solution of chromate of zinc in ammonia and dried, the ammonia evaporates and the chromate of zinc, being insoluble in water, remains imprisoned in the fibers.

In some cases the color is developed by exposing the impregnated fabric to the action of the oxygen of the air. This is called "ageing." When indigo, for example, is mixed with sulphate of iron, lime and water, it dissolves to a nearly colorless liquid, which has the property of absorbing oxygen from the air and turning blue. When cloth is steeped in this liquid and then aged, the change to blue takes place in the fiber.

Some colors are produced by double decomposition. When cloth is dipped in a solution of sulphate of iron and dried, it will turn blue on immersion in a solution of prussiate of potash, the two substances decomposing each other. Professor Chandler mentioned a curious case of restoring the signatures on a bank note, which somebody had taken out with acid. When the ink employed is the ordinary nut-galls and iron compound, a trace of the iron is usually left after treating the writing with acid. Availing himself of this fact, he applied a little prussiate of potash and brought out the signatures very legibly in blue.

A very important means of fixing colors on fabrics is by the use of what are called mordants. Alum is a good example of what is meant by a mordant. When an alkali is added to a solution of alum, a white, gelatinous substance contained in it is thrown down. This is alumina, which has so strong an affinity for coloring matters that it will take them out of solution and precipitate them. When a fabric is impregnated with it and then steeped in the dye, the precipitation will take place in the substance of the stuff. Another mordant is the chloride of tin, which, in addition to fixing the colors, hightens them. Compounds of iron change the tints and enable us to obtain a long series of colors from a single dyestuff.

The last method of fixing colors to be considered is "gumming." This is usually done by means of the white of egg or the curds of milk. Aniline red, for instance, is mixed with the albumen, printed upon cotton and then steamed. The steam cooks the egg and imprisons the color.

The dyes themselves have been divided into substantive and adjective; the former being taken up directly by the fabric, and the latter requiring a mordant. Safflower, for example, is substantive for silk but adjective for cotton.

Dyes are obtained from each of the three kingdoms of nature and from the chemist's laboratory. Some of the most important have been derived from the latter source. Not many years ago the coal tar, obtained from the distillation of coal in making gas, was considered a nuisance and gas companies ran it into the rivers. Now the chemist makes from it about 56 of the most magnificent colors. The Philadelphia gas company is making arrangements for mining it from the bottom of the river, into which they had thrown about $150,000 worth.

The most ancient dye, known as the Tyrian purple, was obtained from two species of shell fish, each of which contained about a drop of it. It was not purple but red, and was considered so precious that a pound of wool dyed with it sold for what is equivalent to about $150 in gold. Cochineal is the dried body of an insect found on a species of cactus cultivated for that purpose in Central America. Its coloring principle is carmine. It is used for dyeing wool scarlet, the mordants being chloride of tin and cream of tartar. With alum, it gives a crimson. The dried precipitate with alum is called crimson lake, a "lake" being a compound of a coloring matter with alumina.

In the vegetable kingdom, the dyes are obtained from the roots, the wood, the bark, the fruit, and in fact from every portion of plants. Among the roots, the most valuable is the madder, largely cultivated in France and other countries. It is estimated that about ten millions of dollars are invested in its cultivation. Before long, however, all this capital must find another employment; for the chemist has succeeded in preparing artificially the alizarin or coloring principle of madder. By the use of different mordants we obtain from madder a great variety of shades, from Turkey red to chocolate. Besides the color, madder contains sugar in such quantity that most of the alcohol in France is manufactured from it. When, therefore, madder ceases to be cultivated, Frenchmen will have to get their whisky from a different source. Alkanet and turmeric are other examples of roots, the latter furnishing us with test paper for alkalies and for boracic acid. Among the woods, logwood, Brazil wood and fustic are the most important. Their coloring principles are extracted by boiling, in a vacuum pan or closed vessel to which an air pump is attached. The air being exhausted, the water boils far below its ordinary boiling point by reason of the diminished pressure. By this method there is no danger of destroying the colors from too high a heat. The same principle is applied to sugar boiling, evaporating down our jellies, etc. A good example of a bark is quercitron, which gives a brilliant yellow. Safflower is the fruit of a species of thistle. This substance, the professor remarked, has stood more in the way of human progress than perhaps any other, being the color with which red tape is dyed. It is almost the only dye which is "substantive" to cotton. Tannic acid, contained in nut galls (the excrescences produced on a species of oak by the sting of an insect), in sumach, etc., gives a black color with salts of iron. Ink is also made from it. Most blacks, however, are made with logwood and acetate of iron or bichromate of potash with the addition of some fustic, because logwood alone gives a blue black. Indigo, which has already been mentioned, is obtained by fermenting the leaves of several species of the *indigofera* genus in water. A yellow liquid is produced, which absorbs oxygen and turns blue. The indigo precipitates, and is sold in cakes. Woad is another similar vegetable blue, chiefly interesting from the fact that the ancient Britons used it as a war paint to smear their bodies with.

Among the mineral dyes, we have a fine yellow made by dipping the cloth first in acetate of lead and then in chromate of potash. To make this orange, it is boiled in lime water. A blue color is made by using, first acetate of iron and then prussiate of potash. Ultramarine, which is now prepared artificially by the chemist, is fastened on to the fabric by means of white of egg. Chrome green, made by heating chromate of potash with borax and treating with water, is used in the same manner.

On distilling coal tar, the first, or light, portion contains benzole, which by means of nitric acid is converted into nitro-benzole or artificial oil of bitter almonds. When this is acted on by acetic acid and iron filings, aniline is the result. By the oxidation of aniline with chloride of tin, arsenic acid, etc., aniline red, fuchsin, or magenta is obtained, and all possible shades between this, through purple and violet to blue, are made by heating it with more aniline and stopping when the desired shade is obtained. Besides these shades, green, black and yellow dyes are made by processes which we must omit for want of space. In the heavier portions of the coal tar distillates is found a substance called anthracene, from which a long series of splendid colors are prepared; among them artificial alizarin, which rivals that from madder in beauty.

The above lecture was copiously illustrated by means of specimens, and a practical dyer produced some beautiful results in silk dyeing before the audience. The portion of the lecture relating to dyeing occupied so much time that the professor was obliged to omit the subject of calico printing.

SANITARY NOTES.---FLAVORING SUBSTANCES FOR FOOD AND DRINK.

The State Board of Health of Massachusetts publish in their fourth annual report a number of very exhaustive and valuable papers on important sanitary questions of the day. These essays are from the pens of well known physicians and scientists, and contain the newest and most reliable information on the subjects of which they treat. As the approaching warm weather renders all matters relating to the public health of timely importance, we shall present, under the heading of "Sanitary Notes," in the present and subsequent articles, condensations of these treatises, in which the various points of interest and conclusions drawn will be carefully retained.

The first essay: "On the character of substances used for flavoring articles of food and drink:" is by Henry K. Oliver, M.D., and the author states that he was led to make the necessary investigations from the fact of having a case brought to his knowledge of the poisoning of five individuals by partaking of *pistache* ice cream. Inquiry into the matter proved that the

ESSENTIAL OIL OF BITTER ALMONDS

used for flavoring always contains prussic acid, which it is safe to infer is not wholly removed fsom the commercial oil. Specimens of the substance used in flavoring the ice cream above referred to were analyzed, and the presence of the deadly poison was clearly determined.

Very little essential oil of bitter almonds is made in this country, but it is largely imported. It is always employed when an almond or peach flavor is desired, one or two drops sufficing to impart the taste to large quantities of material. Some idea of the poisonous nature of the ordinary essential oil may be gathered from the fact that experience has proved that two teaspoonsful have destroyed life in ten minutes. According to Dr. Taylor, one hundred parts of the oil contain nearly thirteen parts of anhydrous prussic acid. One drop is sufficient to kill a cat. It has a yellowish color, a bitter, acid, burning taste and the odor of the almond kernels in a high degree. Virey says that accidents occasionally happen among children in Paris from their eating freely of macaroons, which are sometimes too strongly flavored with the substance. In 1871 one hundred and forty-nine pints of the oil were imported to Boston. Of this quantity, the author estimates that forty-nine pints were employed for flavoring—equal to 2,750 fatal doses. It may not be out of place, he adds, to state what became of the other hundred pints, 5,500 doses; it all went to a manufacturer of patent medicine.

NITRO-BENZOLE, OR OIL OF MIRBANE

is the result of the action of nitric acid on benzole, which is one of the lighter products of the distillation of coal tar. It closely resembles the above described substance, and hence is called artificial oil of bitter almonds. It is principally used in the manufacture of aniline colors and for scenting soap and perfumery, and, on account of its cheapness, it is employed to some extent by confectioners. It is a very active poison, eight or nine drops being sufficient to cause death, and its vapor is also dangerous.

ARTIFICIAL FRUIT ESSENCES.

The compound ethers have been found to possess the odor and flavor of certain fruits, and hence are largely substituted for the genuine sirups and extracts. Butyric ether is prepared by mixing butyric acid with sulphuric acid and alcohol. The former acid is obtained by mixing decaying cheese with grape sugar and chalk, and allowing fermentation to take place. The ether dissolved in another portion of alcohol forms pineapple essence. Pelargonic ether is prepared by digesting pelargonic acid with alcohol at a gentle heat. Pelargonic acid is the result of the action of nitric acid on oil of rue. This ether with alcohol forms quince essence. Acetate of amylic ether, a distilled mixture of fusel oil, acetate of potash, and sulphuric acid, forms the essence of Jargonelle pears. Valerianate of amylic ether, made by the action of sulphuric and valerianic acids on fusel oil, forms apple essence. A mixture of acetate of amylic ether with butyric ether gives banana essence. Other mixtures of ethers, modified by the addition of various agents, as nitrous ether, acetic acid, camphor, tincture of orris, vanilla, the volatile oils, result in imitations of the strawberry, raspberry, apricot, currant, and other flavors. Taken into the stomach in an undiluted form, these compounds would be highly dangerous; but as in confectionery they are largely mixed with other substances, their noxious effects are much lessened. Children are more susceptible to their influence than adults, and have been known, after eating candies with liquids within, to become seized with alarming sedative symptoms requiring prompt medical treatment. These artificial essences, though employed to a great extent for flavoring soda water, are rarely used by reputable druggists, though the latter all agree in substituting citric or tartaric acid for lemon juice, on account of the difficulty of keeping sirup made from that fruit Both of these acids are derived from fruit and hence are not deleterious in an occasional summer beverage. Sarsaparilla sirup, sold by street pedlars of soda water, is generally innocent of the root, being nothing more than molasses and water flavored with oil of anise. Cochineal is generally added to give sirups an attractive color.

SPURIOUS ALCOHOLIC LIQUORS.

The most important part of Dr. Oliver's report is under the above heading, and it exposes the abominable compounds which are sold to the poorer classes in the reeking taverns and gin mills in the obscure portions of great cities. An individual named Eichler (we give him the gratuitous advertisement) publishes a circular giving recipes for the composition of these liquid poisons, which he says will save hundreds of dollars to those in the business. We select a few of these recipes at random, from a long array: *New York Whisky.*—Concentrated essence Bourbon, four ounces; compound tincture of green tea, one pint; tincture of capsicum, one pint: tincture of grains of paradise, one pint; corn whisky, twenty gallons; water, twenty gallons. *Port wine.*—For forty gallons. Port wine ether, four ounces; aromatic tincture, eight ounces; tincture of rhatany, eight ounces; tincture of orris, twelve ounces; simple sirup, three gallons; rectified spirits, three gallons; wine coloring, two gallons; plain or raisin wine or fermented cider, thirty-two gallons." The former recipe, it will be noted, contains less than half poor whisky, and the latter not a drop of the wine it is intended to represent. "An imitation champagne is made of a delectable compound of sugar, water, white argols, cider, and yeast," mixed with a little rectified spirits and orris; and even so innocent a beverage as sweet cider is counterfeited by water with a little cider flavoring, brown sugar, and yeast. The manufacturer, with an impudence which borders closely upon the sublime, remarks that these doses "improve very much by age."

TARTARIC ACID AS A SUBSTITUTE FOR FRUIT

is put up in boxes and sold as "fruitina." "One package," says the maker's circular, "makes twenty-five pies or sixteen pounds of jelly. Twenty-five pies for thirty-five cents." As might be imagined, it is endorsed by forty female names, the owners of which are principally boarding house keepers. Some of the prescriptions for its use are refreshing; for instance: "To make lemon pie: Pare and boil a *turnip*, add a teaspoonful of fruitina and a cup of sugar; season and bake." A quantity of common starch, fruitina, flavoring matter and sugar makes "a delicious jelly," and a wonderful mixture of the acid, molasses, milk, eggs, crackers, and spice undergoes some incomprehensible change in the oven which transforms it into a "pumpkin pie." Tartaric and citric acids, even in considerable quantities, may be swallowed without fatal results, and, dissolved in water, form a refreshing drink in fevers; but it is a cheat to use either of them as a substitute for fruit in domestic economy, and it is not unlikely that they may do harm if partaken of too freely.

As regards the opinion that strychnin is used to impart a bitter flavor to ales and beers, the writer considers it erroneous. English imported ales are absolutely pure, a fact determined by careful analysis of samples from different breweries throughout the kingdom.

A PLANT has been discovered in Angola, Africa, so sensitive that it closes its leaves at the mere sound of a footfall.