INDUSTRIAL CHEMISTRY

Chardonnet on Artificial Silk

"A Classic of Science"

A famous chemist presents an early view of a discovery which has since developed into great industry

No slur on the genuineness of the product, but rather exultation in another victory over nature, was meant by "artificial" silk as Chardonnet used it. Nitrate silk made by his process is one of the "rayons" of commerce today, though three other processes are also in use. In all the underlying principle is the same. Cellulose is dissolved, the solution is squirted through a small hole into a liquid which will solidify the cellulose again in the form of a continuous thread. This thread is then handled like that of any other textile.

SUR UNE SOIE ARTIFICIELLE. Note de M. Chardonnet, présentée per M. A. Cornu. Comptes Rendus hebdomadaires des Séances de L'Academie des Sciences, Paris, 1889. Translated for the Science News Letter by Helen M. Davis.

IN the month of May, 1884, when M. Blanchard, president for that year, laid before the Academy of Sciences the problem of imitation of silk, I sent the Secretary a sealed communication, opened at the meeting of November 7, 1887, summing up my first studies on this question.

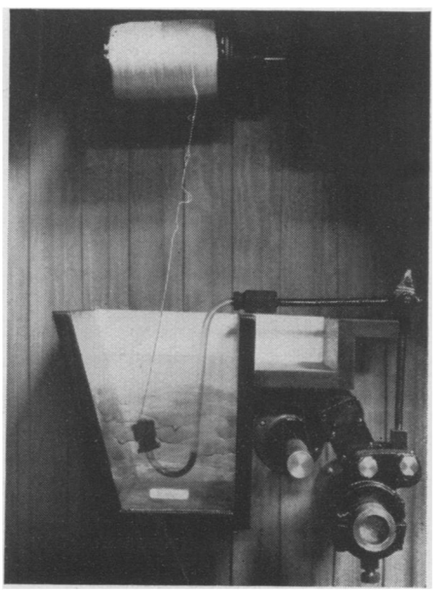
The continuity of thread, its transparence, the interior play of light, the silky sheen, could only be obtained by making thread from a liquid solution. Cellulose ought to do, but it does not have a true solvent: it would be necessary to nitrate it, to thread it as collodion, and then to relieve it of a part of its nitric acid.

Various celluloses may be used, on condition that they are pure and are not changed by the reagents. I have directed my attention chiefly to cotton and sulphite wood pulp.

With these materials, a pure cellulose octonitrate is formed, and dissolved in the ratio of 6.5 to 100 in a mixture of 38 parts of ether and 42 of alcohol.

This collodion is held in a tinned copper reservoir, where an air pump maintains a pressure greater than atmospheric, it flows down an incline in which are set glass tubes ending in a capillary portion A. A second tube B surrounds each of the first and receives an excess of water by the tubulure C. This water, held back by a covering of rubber D, falls back around B. The collodion, driven out through the opening A, is immediately solidified, at the surface, upon contact with the water, and falls with this water, in the state of a thread, around B; there, tongs automatically driven catch it and carry it to bobbins turning above. The threads from neighboring orifices are united into a kind of raw silk. Each orifice is provided with a stop-valve to regulate the size of the thread. In the industry, in order not to lose the solvent, orifices and bobbins are enclosed in a glass case, where the same amount of air is constantly reheated at the entrance to the machine (to dry the thread) and cooled at the outlet (to condense the vapors). The skeins are handled like cocoon silk. After this they go on to the denitrification.

The various pyroxyles lose their nitric acid in a warm reducing bath and also in pure water, but the reaction is more complete in dilute nitric acid. The nitric acid is removed from the cellulose by *dissociation* which progresses faster the hotter and more concentrated the bath, but which can be pushed the further as the bath is cooler and the more dilute. I use nitric acid of density 1.32; the temperature is allowed to fall slowly from 35° to 25°. At the end, the cellulose should be gelatinous, particularly apt to absorb by endosmosis various substances, especially coloring matter and salts. It gives off no more than 100 cc. to 110 cc. of nitrogen dioxide per gram. The solvents of collodion have no more effect upon it, the threads have lost their explosive properties and can be used without danger in most applications, especially combined with other textiles; but it is possible to make them less combustible perhaps than the hemp or cotton used



THREADS OF ARTIFICIAL SILK

Are made by this model which is on exhibit in the U. S. National Museum. It differs from a commercial machine only in having one spinneret instead of many

with them by absorbing, upon leaving the nitric bath, some ammonium phosphate. (This last combination, of cellulose and salt, on account of water held hygrometrically, loses 85 cc. to 90 cc. of nitrogen dioxide per gram.)

The density of artificial silk, about 1.49, is comprised between that of raw silk (about 1.66) and that of manufactured silk (about 1.43). The tensile strength varies from 25 kg. to 35 kg. per square millimeter (30 to 45 for raw silk from the cocoon, 15 or 20 to 100 or less for manufactured silk). The elasticity of natural and artificial silks is analogous (elasticity of test, that is to say, elongation before rupture, 15 to 25 in 100; true elasticity, 4 to 5 in 100 approximately). The diameter of artificial silk can vary from less than 1 *mu* to more than 40 *mu;* the flexibility can therefore be regulated to suit the desired end. The *brilliance* surpasses that of cocoon silk itself.

It can also be dyed by ordinary processes: artificial silk is indeed the only fiber which behaves in the bath about

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like cocoon silk (on condition that it is not heated too much). Although I have not had at my disposal either complete equipment or trained workmen, I can exhibit at the Champ-de-Mars some samples imitating all the types of silk.

The section of artificial silk threaded into water (as is described above) shows every staple in the form of a fluted cylinder: this is caused by shrinkage of the center after solidification of the envelope. If the water is replaced by alcohol, the superficial skin remains retractile and the cylinder circular.

We have tried to modify the process by dissolving the pyroxyle in acetic acid to incorporate it into the gelatine; but the thread becomes friable and loses all its practical value.

I close with the observation: the thread of silk formed of two filaments of fibroin joined by the sericin (grès) must be, it seems to me, the product of two different secretions; the fibroin must be already formed in the *silk organs;* the sericin must be secreted by the lips of the spinnerets; the contact of the two liquids must bring about their coagulation. I venture to call this point to the attention of naturalists.

Scienee News Letter, November 8, 1930

For generations ink has been a successful household remedy in the Philippines for the treatment of burns, Dr. C. A. Stammel, Captain, M. C., U. S. Army, has reported from Zamboanga, P. I., to the American Medical Associaton. The surprising thing is that a scientific basis for the treatment exists, although it has only just been revealed.

Most black inks are simply weak solutions of an iron and tannic acid compound, Dr. Stammel pointed out, and scientists have recently discovered that tannic acid itself is an efficient method of treating burns.

NEXT WEEK'S 141ST CLASSIC is by

Johann Kepler

discoverer of planetary lanes who died

THREE HUNDRED YEARS AGO

November 15, 1630

PUBLIC HEALTH

Cancer Education Urged Pending Discovery of Cure

Public Health Association Also Hears Reports of Botulism Increases and of Tides Making Mussels More Poisonous

ORGANIZATION of each state to fight cancer through its board of health, medical society and university, using educational programs and clinics as the weapons, was proposed by Dr. Joseph Colt Bloodgood of Baltimore, at the meeting of the American Public Health Association in Fort Worth, Texas, last week.

"In spite of many laboratories throughout the world searching for a cure or means of prevention, nothing is in sight, and as yet there is no protection against death from cancer except education," Dr. Bloodgood declared.

He described in detail the Massachusetts state program for the control of cancer. In this state the board of health is directed by law to maintain and advertise cancer clinics on a certain number of days throughout the year in as many localities as possible, and money has been appropriated for their maintenance.

Our only effective treatments for cancer today, surgery and irradiation with X-rays and radium, do not permanently cure more than one tenth of the cases that come late for treatment. These same methods applied early in the disease effect permanent cures in from thirty to seventy per cent. Consequently education is a vital factor in the control of the disease.

"Until in the laboratories we have found the cause, prevention and cure, something must be done on a world-wide plan which will inform the public and the children about the protection that is possible today," he said.

This educational program need not mean the encroachment of state medicine on private practice, he indicated. The most valuable preventive medicine can be practiced by the family physician who not only cares for the sick but also makes periodic examinations of well people and acts as a bureau of information on the best and latest methods of prevention of disease and the regulation of health. However, for those who cannot afford a family physician, clinics must be provided.

"The great leaders in public health today recognize cancer as a world public health problem, as a local problem in the smallest places. Every modern student of cancer knows that in the skin and mouth cancer is a preventable disease, and believes that if every woman who has borne children received a periodic examination, cancer of the cervix can be placed among the preventable diseases," Dr. Bloodgood concluded.

Botulism Increases Reported

A definite increase in the number of cases of botulism has occurred during the past two years, was reported by Dr. K. F. Meyer, director of the Hooper Foundation for Medical Research of the University of California. With the exception of two cases of botulism traced to shalots packed in Italy, home preserved vegetables, fruits, fish and meats have been the products responsible for the cases of poisoning in the recent outbreaks.

Botulism is a type of food poisoning caused by the presence in the food of an organism called Clostridium botulinum. This organism liberates a very powerful poison which causes illness and often death in persons eating infected food. Certain types of food are particularly apt to contain the organism, and home canned or preserved foods are more apt to have it now than commercial products.

Poison Follows Tides

Pacific Coast mussels are most poisonous soon after or during the maximum tides of the year, Dr. K. F. Meyer, director of the Hooper Foundation for Medical Research of the University of California, reported.

Mussels collected at various places, from as far south as Monterey Bay to as far north as the mouth of the Klamath River near the northern border of California, contain a small amount of typical mussel poison at any time of the year.

"Since the mussels are consumed in large quantities without ill effects by the population along the coast, it is reason-